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Patentanmeldung Nr. Patent application No. Demande de brevet n°

03104562.8

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

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Anmeldung Nr:
Application no.: 03104562.8
Demande no:

Anmelde tag:
Date of filing: 05.12.03.
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

Ciba Specialty Chemicals Holding Inc.
Klybeckstrasse 141
4002 Basel
SUISSE

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
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Electroluminescent Device

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s)
revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

H05B33/00

Am Anmelde tag benannte Vertragstaaten/Contracting states designated at date of
filling/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL
PT RO SE SI SK TR LI

ELECTROLUMINESCENT DEVICE

The present invention relates to organo-electroluminescent (EL) devices, in particular EL devices that comprise durable, blue-emitting organo-electroluminescent layers. The organo-
5 electroluminescent layers comprise certain 2H-benzotriazoles.

Progress has been made towards developing organic-based electroluminescent devices suitable for full color displays. Generally, an EL device is comprised of a light-emitting layer or layers and a pair of facing electrodes sandwiching the light-emitting layer(s). Application
10 of an electric field between the electrodes results in the injection of electrons and holes to the system, resulting in the release of energy as light.

However, organo EL devices have not been developed that have suitable stability under continuous operation. In particular, there remains a need for blue-emitting, stable organo EL devices.

15 U.S. Pat. No. 5,104,740 teaches an electroluminescent element that comprises a fluorescent layer containing a coumarinic or azacoumarinic derivative and a hole transport layer, both made of organic compounds and laminated on top of the other. Certain of the coumarinic compounds disclosed have 2H-benzotriazole substituents.

U.S. Pat. No. 6,280,859 discloses certain polyaromatic organic compounds for use as a light-
20 emitting material in organo-electroluminescent devices. A 2H-benzotriazole moiety is listed among a long list of possible divalent aromatic linking groups.

U.S. Pat. No. 5,116,708 is aimed at a hole transport material for EL devices.

U.S. Pat. No. 5,518,824 teaches an EL device comprising one or more organic layers, wherein at least one of the layers is obtained by thermal or radiation-induce crosslinking.

25 Certain benzotriazoles are disclosed as suitable charge transport compounds.

U.S. Pat. No. 4,533,612 discloses electrophotographic recording materials that comprise certain 2H-benzotriazoles as charge carrier-transporting compounds.

JP 58009151 discloses the use of certain polyaromatic benzotriazole systems in a charge transport layer of an electrophotographic photoreceptor.

30 U.S. Pat. No. 5,629,389 discloses an electroluminescent device having a layer that comprises 2-(2H-benzotriol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol.

EP 764712 discloses ortho hydroxyphenyl-2H-benzotriazoles as stabilizers in EL devices.

Tsutsui, et al., in *Synthetic Metals*, 1997 (85) 1201-1204, discloses 2-(2-hydroxy-5-methylphenyl)-2H-benzotriazole as a fluorescence quencher in an electron transport layer.

U.S. Pat. No. 2,784,183, 2,713,056, 2,784,197, 3,288,786, 3,341,530, 5,006,662, GB-A-1150408, DE-A-1052405, and DE-A-1919181 disclose naphthobenzotriazoles used as optical brighteners.

U.S. Pat. No. 3,793,315 teaches stilbenyl benzotriazole derivatives as optical brighteners.

5 Woessner, et al., in *J. Phys. Chem.*, 1985 (89), 3629-3636 studied the emission of 2-(2-hydroxy-5-methylphenyl)-2H-benzotriazole, and the methoxy analogue thereof.

U.S. Pat. No. 5,486,406 teaches the use of metal complexes of ortho hydroxyphenyl-2H-benzotriazoles in organic light emitting devices.

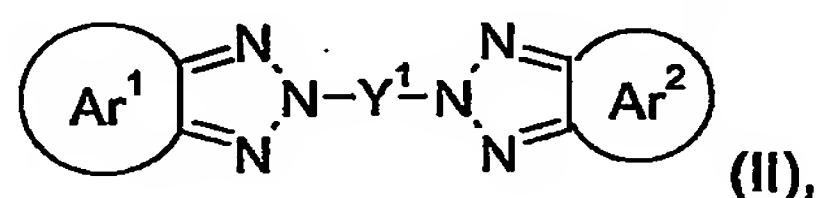
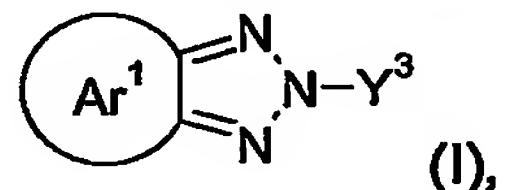
JP 00256667 and JP 98140145 disclose metal complexes of ortho hydroxyphenyl-2H-

10 benzotriazoles for use in electroluminescent devices.

Certain 2H-benzotriazole derivatives are found to be suitable for use in organo-electroluminescent devices. In particular, certain 2H-benzotriazole derivatives are suitable blue emitters with good durability.

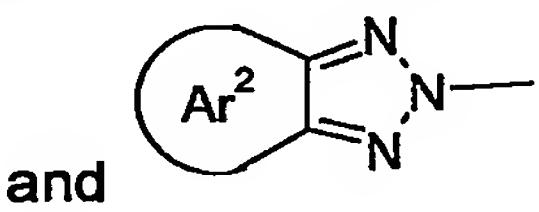
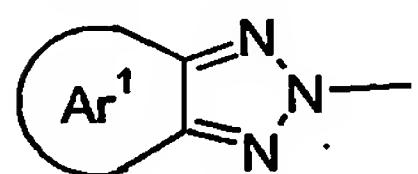
15

Accordingly, the present invention relates to 2H-benzotriazole compounds of the formula

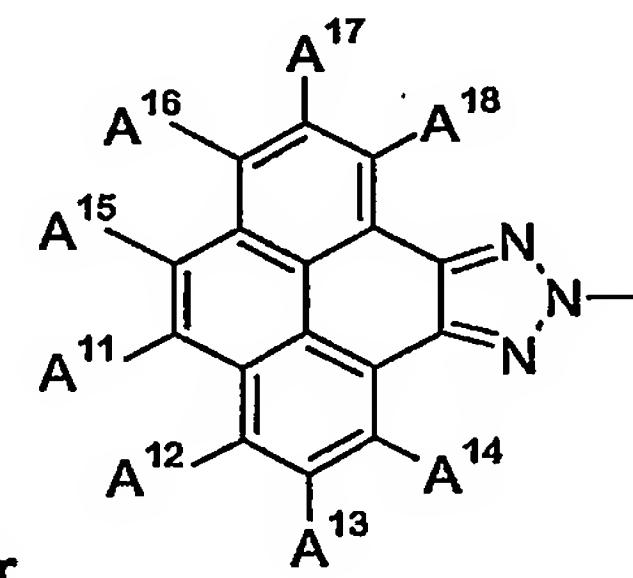
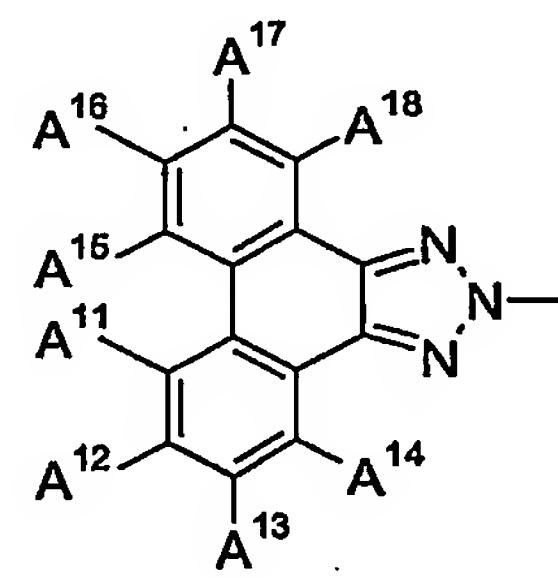
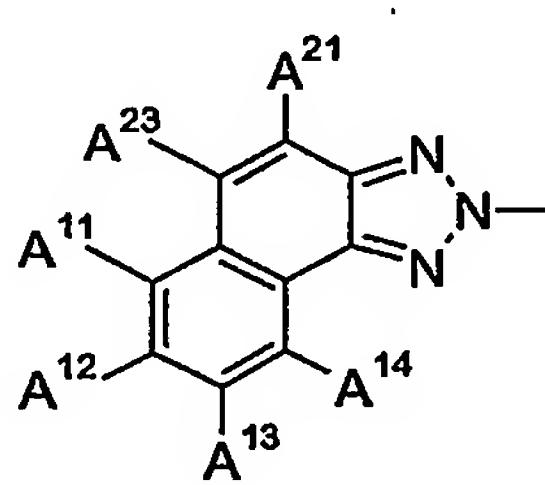
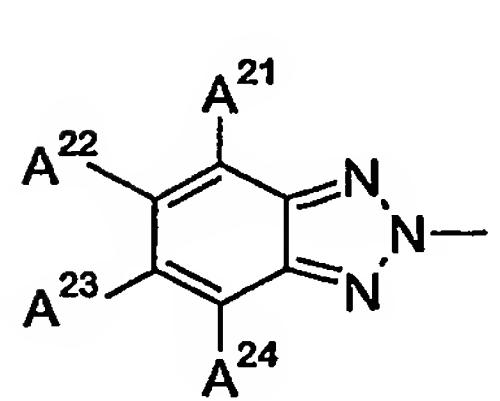


20 Y¹ is a divalent linking group, and

Y³ is C₁-C₂₅alkyl, especially C₁-C₄alkyl, aryl or heteroaryl, which can optionally be substituted, especially C₆-C₃₀aryl, or a C₂-C₂₆heteroaryl, which can optionally be substituted,



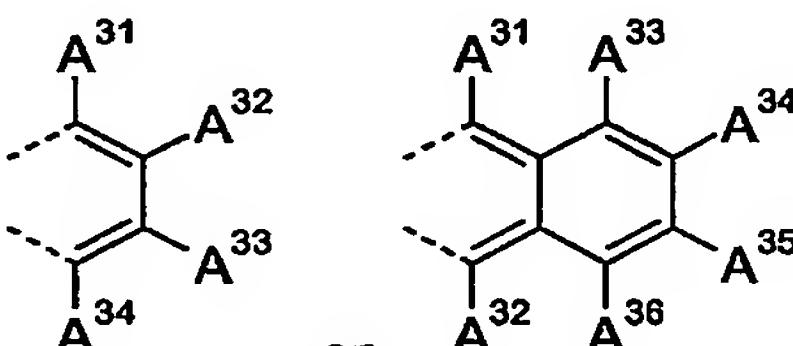
and are independently of each other a group of formula



, or

25 wherein

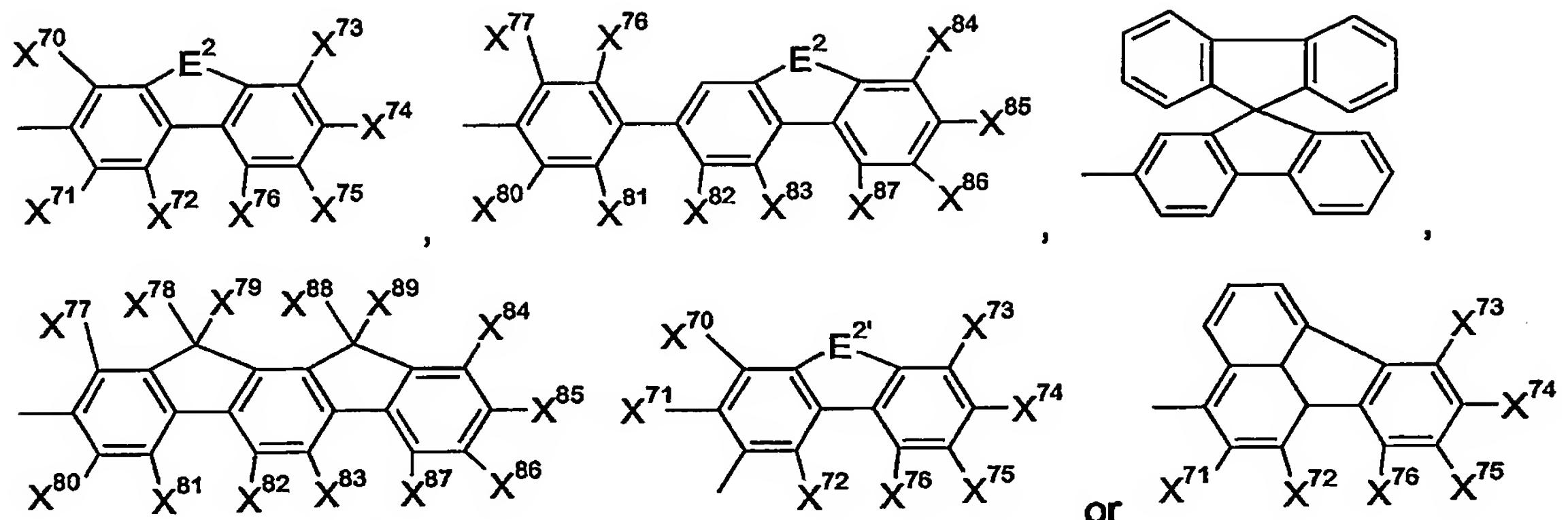
$A^{21}, A^{22}, A^{23}, A^{24}, A^{11}, A^{12}, A^{13}, A^{14}, A^{15}, A^{16}, A^{17}$ and A^{18} are independently of each other H, halogen, especially fluorine, hydroxy, $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkyl}$ which is substituted by E and/or interrupted by D, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$ which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, -NR²⁵R²⁶, $C_1\text{-}C_{24}\text{alkylthio}$, -PR³²R³², $C_5\text{-}C_{12}\text{cycloalkoxy}$, $C_5\text{-}C_{12}\text{cycloalkoxy}$ which is substituted by G, $C_6\text{-}C_{24}\text{aryl}$, $C_6\text{-}C_{24}\text{aryl}$ which is substituted by G, $C_1\text{-}C_{24}\text{alkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, or $C_1\text{-}C_{24}\text{haloalkyl}$; $C_2\text{-}C_{20}\text{heteroaryl}$, $C_2\text{-}C_{20}\text{heteroaryl}$ which is substituted by G, fluorine, $C_1\text{-}C_{24}\text{alkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, or $C_1\text{-}C_{24}\text{haloalkyl}$; $C_2\text{-}C_{24}\text{alkenyl}$, $C_2\text{-}C_{24}\text{alkynyl}$, $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkoxy}$ which is substituted by E and/or interrupted by D, $C_7\text{-}C_{25}\text{aralkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, which is substituted by G, $C_7\text{-}C_{25}\text{aralkoxy}$, $C_7\text{-}C_{25}\text{aralkoxy}$ which is substituted by G, or -CO-R²⁸, or



A^{22} and A^{23} or A^{11} and A^{23} are a group , or , or

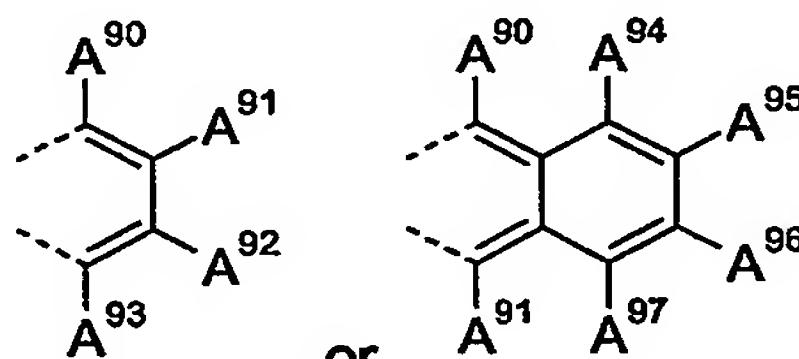
15 two groups $A^{11}, A^{12}, A^{13}, A^{14}, A^{15}, A^{16}, A^{17}$ and A^{18} , which are neighbouring to each other, are

a group , or , wherein $A^{31}, A^{32}, A^{33}, A^{34}, A^{35}$ and A^{36} are independently of each other H, halogen, hydroxy, $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkyl}$ which is substituted by E and/or interrupted by D, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$ which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, $C_5\text{-}C_{12}\text{cycloalkoxy}$, $C_5\text{-}C_{12}\text{cycloalkoxy}$ which is substituted by G, $C_6\text{-}C_{24}\text{aryl}$, $C_6\text{-}C_{24}\text{aryl}$ which is substituted by G, $C_2\text{-}C_{20}\text{heteroaryl}$, $C_2\text{-}C_{20}\text{heteroaryl}$ which is substituted by G, $C_2\text{-}C_{24}\text{alkenyl}$, $C_2\text{-}C_{24}\text{alkynyl}$, $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkoxy}$ which is substituted by E and/or interrupted by D, $C_7\text{-}C_{25}\text{aralkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, which is substituted by G, $C_7\text{-}C_{25}\text{aralkoxy}$, $C_7\text{-}C_{25}\text{aralkoxy}$ which is substituted by G, or -CO-R²⁸, wherein preferably at least one of the substituents $A^{21}, A^{22}, A^{23}, A^{24}, A^{11}, A^{12}, A^{13}, A^{14}, A^{15}, A^{16}, A^{17}$ and A^{18} is $C_6\text{-}C_{24}\text{aryl}$ which is substituted by fluorine, $C_1\text{-}C_{24}\text{alkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, or $C_1\text{-}C_{24}\text{haloalkyl}$; or $C_2\text{-}C_{26}\text{heteroaryl}$, especially thiophenyl, pyrrolyl, furanyl, benzoxazolyl, or benzothiazolyl, which is substituted by fluorine, $C_1\text{-}C_{24}\text{alkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, or $C_1\text{-}C_{24}\text{haloalkyl}$, or



wherein X^{70} , X^{71} , X^{72} , X^{73} , X^{74} , X^{75} , X^{76} , X^{77} , X^{80} , X^{81} , X^{82} , X^{83} , X^{84} , X^{85} , X^{86} , and X^{87} are independently of each other E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-

5 C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, -NR²⁵R²⁶, C₁-C₂₄alkylthio, -PR³²
R³², C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl
which is substituted by G, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl,
C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl; C₂-C₂₀heteroaryl, C₂-
10 C₂₀heteroaryl which is substituted by G, fluorine, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl,
C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl;
C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or
interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-
C₂₅aralkoxy which is substituted by G, or -CO-R²⁸, or
15 two groups X^{70} , X^{71} , X^{72} , X^{73} , X^{74} , X^{75} , X^{76} , X^{77} , X^{80} , X^{81} , X^{82} , X^{83} , X^{84} , X^{85} , X^{86} , and X^{87} , which



are neighbouring to each other, are a group , or , wherein A⁹⁰, A⁹¹,
A⁹², A⁹³, A⁹⁴, A⁹⁵, A⁹⁶ and A⁹⁷ are independently of each other H, halogen, especially fluorine,
hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-
C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-

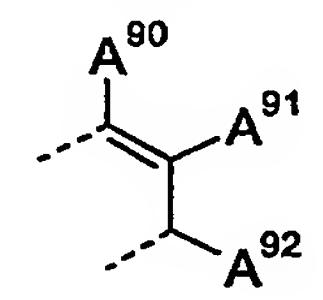
20 C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-
C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is
substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl,
C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D,
C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which
25 is substituted by G, or -CO-R²⁸,
E² is -CR²³=CR²⁴-, especially -CX⁶⁸X⁶⁹-,

E^2 is $-\text{SiR}^{30}\text{R}^{31}-$; $-\text{POR}^{32}-$; especially $-\text{S}-$, $-\text{O}-$, or $-\text{NR}^{25}'-$, wherein R^{25}' is $\text{C}_1\text{-C}_{24}\text{alkyl}$, or $\text{C}_6\text{-C}_{10}\text{aryl}$,

X^{68} , X^{69} , X^{78} , X^{79} , X^{88} and X^{89} are independently of each other $\text{C}_1\text{-C}_{18}\text{ alkyl}$, $\text{C}_1\text{-C}_{24}\text{alkyl}$ which is substituted by E and/or interrupted by D , $\text{C}_6\text{-C}_{24}\text{aryl}$, $\text{C}_6\text{-C}_{24}\text{aryl}$ which is substituted by G ,

5 $\text{C}_2\text{-C}_{20}\text{heteroaryl}$, $\text{C}_2\text{-C}_{20}\text{heteroaryl}$ which is substituted by G , $\text{C}_2\text{-C}_{24}\text{alkenyl}$, $\text{C}_2\text{-C}_{24}\text{alkynyl}$, $\text{C}_1\text{-C}_{24}\text{alkoxy}$, $\text{C}_1\text{-C}_{24}\text{alkoxy}$ which is substituted by E and/or interrupted by D , or $\text{C}_7\text{-C}_{25}\text{aralkyl}$, or

X^{78} and X^{79} , and/or X^{88} and X^{89} form a ring, especially a five- or six-membered ring, or



X^{68} and X^{70} , X^{69} and X^{73} , X^{77} and X^{78} and/or X^{84} and X^{89} are a group

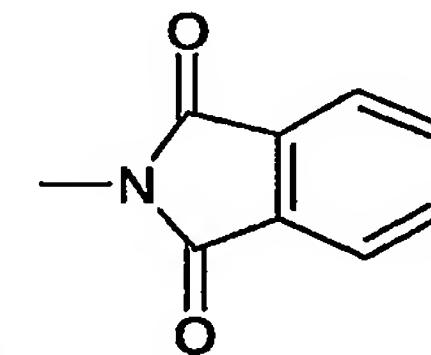
10 D is $-\text{CO-}$; $-\text{COO-}$; $-\text{S-}$; $-\text{SO-}$; $-\text{SO}_2-$; $-\text{O-}$; $-\text{NR}^{25}'-$; $-\text{SiR}^{30}\text{R}^{31}-$; $-\text{POR}^{32}-$; $-\text{CR}^{23}=\text{CR}^{24}-$; or $-\text{C}\equiv\text{C-}$; and

E is $-\text{OR}^{29}$; $-\text{SR}^{29}$; $-\text{NR}^{25}\text{R}^{26}$; $-\text{COR}^{28}$; $-\text{COOR}^{27}$; $-\text{CONR}^{25}\text{R}^{28}$; $-\text{CN}$; $-\text{OCOOR}^{27}$; or halogen;

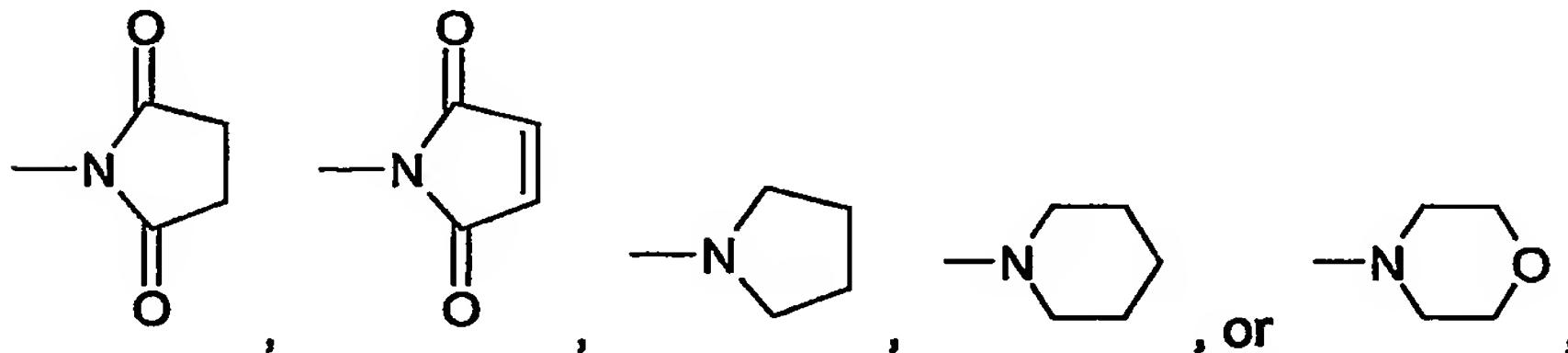
G is E , or $\text{C}_1\text{-C}_{24}\text{alkyl}$, wherein

R^{23} , R^{24} , R^{25} and R^{26} are independently of each other H ; $\text{C}_6\text{-C}_{18}\text{aryl}$; $\text{C}_6\text{-C}_{18}\text{aryl}$ which is

15 substituted by $\text{C}_1\text{-C}_{24}\text{alkyl}$, or $\text{C}_1\text{-C}_{24}\text{alkoxy}$; $\text{C}_1\text{-C}_{24}\text{alkyl}$; or $\text{C}_1\text{-C}_{24}\text{alkyl}$ which is interrupted by $-\text{O-}$; or



R^{25} and R^{26} together form a five or six membered ring, in particular



R^{27} and R^{28} are independently of each other H ; $\text{C}_6\text{-C}_{18}\text{aryl}$; $\text{C}_6\text{-C}_{18}\text{aryl}$ which is substituted by

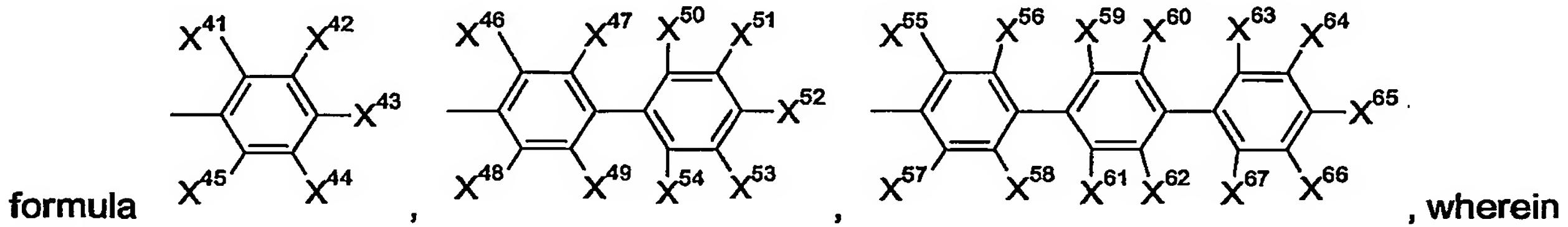
20 $\text{C}_1\text{-C}_{24}\text{alkyl}$, or $\text{C}_1\text{-C}_{24}\text{alkoxy}$; $\text{C}_1\text{-C}_{24}\text{alkyl}$; or $\text{C}_1\text{-C}_{24}\text{alkyl}$ which is interrupted by $-\text{O-}$,

R^{29} is H ; $\text{C}_6\text{-C}_{18}\text{aryl}$; $\text{C}_6\text{-C}_{18}\text{aryl}$, which is substituted by $\text{C}_1\text{-C}_{24}\text{alkyl}$, or $\text{C}_1\text{-C}_{24}\text{alkoxy}$; $\text{C}_1\text{-C}_{24}\text{alkyl}$; or $\text{C}_1\text{-C}_{24}\text{alkyl}$ which is interrupted by $-\text{O-}$,

R^{30} and R^{31} are independently of each other $\text{C}_1\text{-C}_{24}\text{alkyl}$, $\text{C}_6\text{-C}_{18}\text{aryl}$, or $\text{C}_6\text{-C}_{18}\text{aryl}$, which is substituted by $\text{C}_1\text{-C}_{24}\text{alkyl}$, and

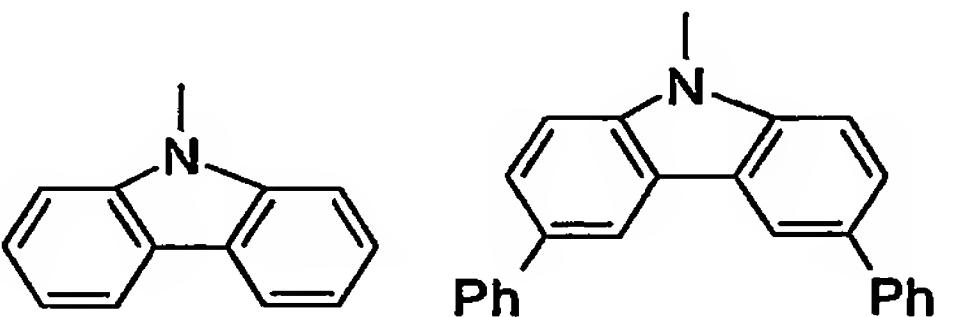
25 R^{32} is $\text{C}_1\text{-C}_{24}\text{alkyl}$, $\text{C}_6\text{-C}_{18}\text{aryl}$, or $\text{C}_6\text{-C}_{18}\text{aryl}$, which is substituted by $\text{C}_1\text{-C}_{24}\text{alkyl}$.

In a preferred embodiment of the present invention at least one of the substituents A²¹, A²², A²³, A²⁴, A¹¹, A¹², A¹³, A¹⁴, A¹⁵, A¹⁶, A¹⁷ and A¹⁸, especially A¹², A²¹ and/or A²³, are a group of

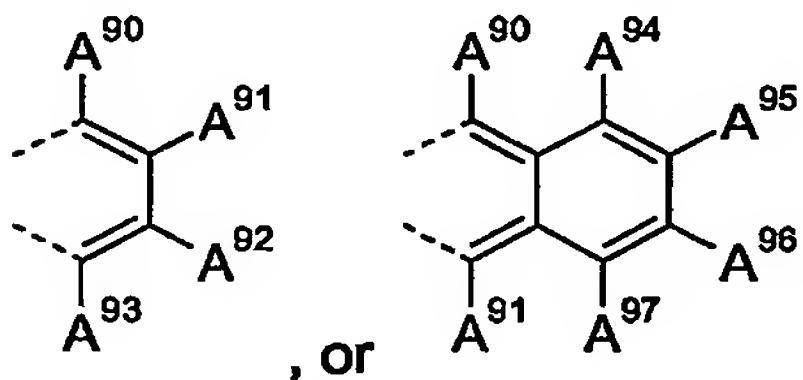


X⁴¹, X⁴², X⁴³, X⁴⁴, X⁴⁵, X⁴⁶, X⁴⁷, X⁴⁸, X⁴⁹, X⁵⁰, X⁵¹, X⁵², X⁵³, X⁵⁴, X⁵⁵, X⁵⁶, X⁵⁷, X⁵⁸, X⁵⁹, X⁶⁰, X⁶¹,

5 X⁶², X⁶³, X⁶⁴, X⁶⁵, X⁶⁶ and X⁶⁷ are independently of each other H, fluorine, -NR²⁵R²⁶, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl, C₁-C₂₄alkyl, which is optionally substituted by E and/or interrupted by D, C₁-C₂₄alkenyl, which is optionally substituted by E, C₅-C₁₂cycloalkyl, which is optionally substituted by G, C₅-C₁₂cycloalkoxy, which is optionally substituted by G, C₆-C₁₈aryl, which is optionally substituted by G, C₁-C₂₄alkoxy, which is optionally substituted by E and/or interrupted by D, C₆-C₁₈aryloxy, which is optionally substituted by G, C₇-C₁₈arylalkoxy, which is optionally substituted by G, C₁-C₂₄alkylthio, which is optionally substituted by E and/or interrupted by D, C₂-C₂₀heteroaryl which is substituted by G, or C₆-C₁₈aralkyl, which is optionally substituted by G, or



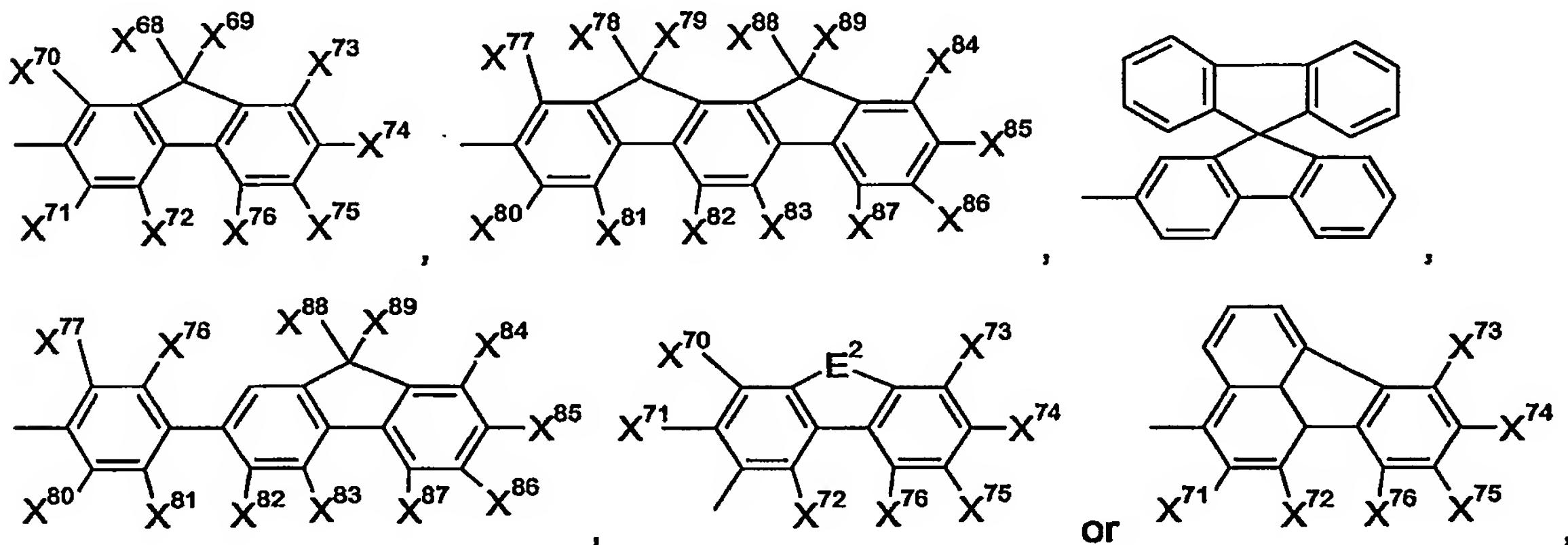
15 X⁴³, X⁶⁵ or X⁵² are a group of formula  , Ph, two groups X⁴¹, X⁴², X⁴³, X⁴⁴, X⁴⁵, X⁴⁶, X⁴⁷, X⁴⁸, X⁴⁹, X⁵⁰, X⁵¹, X⁵², X⁵³, X⁵⁴, X⁵⁵, X⁵⁶, X⁵⁷, X⁵⁸, X⁵⁹, X⁶⁰, X⁶¹, X⁶², X⁶³, X⁶⁴, X⁶⁵, X⁶⁶ and X⁶⁷, which are neighbouring to each other, are a group



20 , or , wherein A⁹⁰, A⁹¹, A⁹², A⁹³, A⁹⁴, A⁹⁵, A⁹⁶ and A⁹⁷ are independently of each other H, halogen, hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by E, or -CO-R²⁸, wherein R²⁵, R²⁶ and R²⁸, D, E and G are as defined above and preferably at least one of the substituents X⁴¹, X⁴²,

$X^{43}, X^{44}, X^{45}, X^{46}, X^{47}, X^{48}, X^{49}, X^{50}, X^{51}, X^{52}, X^{53}, X^{54}, X^{55}, X^{56}, X^{57}, X^{58}, X^{59}, X^{60}, X^{61}, X^{62}, X^{63}$, X^{64}, X^{65}, X^{66} and X^{67} is fluorine, $-NR^{25}R^{26}$, $C_1\text{-}C_{24}\text{alkyl}$, $C_5\text{-}C_{12}\text{cycloalkyl}$, $C_7\text{-}C_{25}\text{aralkyl}$, $C_1\text{-}C_{24}\text{perfluoroalkyl}$, $C_6\text{-}C_{14}\text{perfluoroaryl}$, especially pentafluorophenyl, or $C_1\text{-}C_{24}\text{haloalkyl}$.

5 In another preferred embodiment of the present invention at least one of the substituents A^{21} , A^{22} , A^{23} , A^{24} , A^{11} , A^{12} , A^{13} , A^{14} , A^{15} , A^{16} , A^{17} and A^{18} , especially A^{12} and/or A^{23} are a group of formula

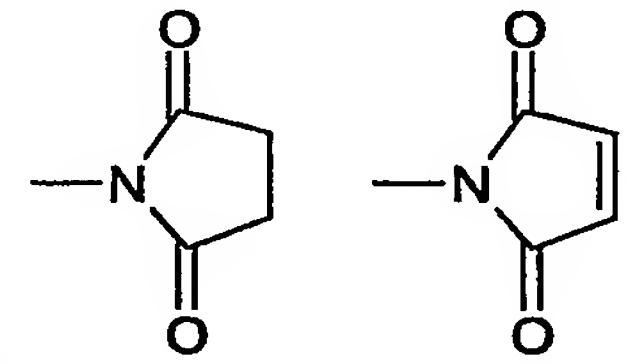


10 wherein

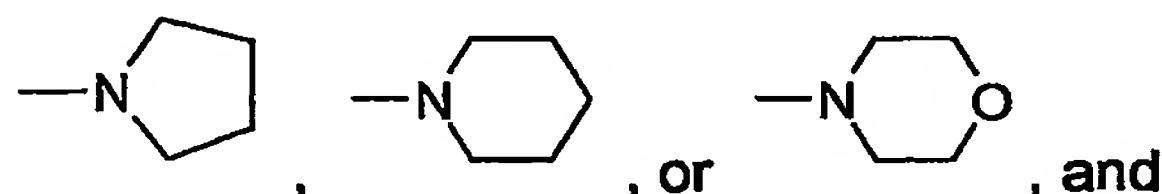
$X^{68}, X^{69}, X^{78}, X^{79}, X^{88}$ and X^{89} are independently of each other $C_1\text{-}C_{24}\text{alkyl}$, especially $C_1\text{-}C_{12}\text{alkyl}$, which can be interrupted by one or two oxygen atoms,
 $X^{70}, X^{71}, X^{72}, X^{73}, X^{74}, X^{75}, X^{76}, X^{77}, X^{80}, X^{81}, X^{82}, X^{83}, X^{84}, X^{85}, X^{86}$ and X^{87} are independently of each other H, CN, $C_1\text{-}C_{24}\text{alkyl}$, $C_6\text{-}C_{10}\text{aryl}$, $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkylthio}$, $-NR^{25}R^{26}$,

15 $-\text{CONR}^{25}R^{26}$, or $-\text{COOR}^{27}$, wherein

R^{25} and R^{26} are independently of each other H, $C_6\text{-}C_{18}\text{aryl}$, $C_7\text{-}C_{18}\text{aralkyl}$, or $C_1\text{-}C_{24}\text{alkyl}$, and R^{27} is $C_1\text{-}C_{24}\text{alkyl}$, or



R^{25} and R^{26} together form a five or six membered ring, in particular

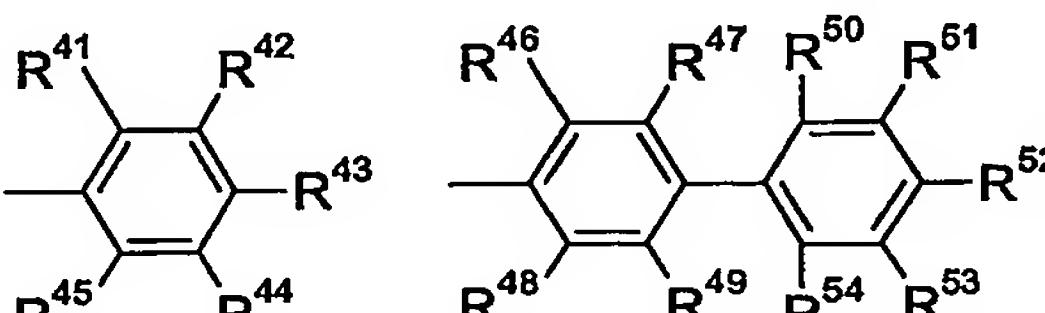


20 E^2 is $-\text{S}-$, $-\text{O}-$, or $-\text{NR}^{25}-$, wherein R^{25} is $C_1\text{-}C_{24}\text{alkyl}$, or $C_6\text{-}C_{10}\text{aryl}$.

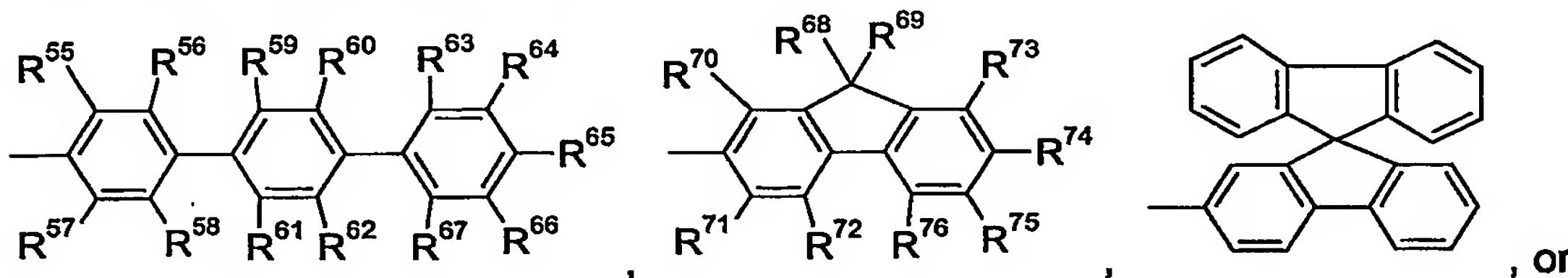
The 2H-benzotriazole compound or compounds should emit light below about 520 nm, especially between about 380 nm and about 520 nm. The 2H-benzotriazole compound or compounds should have a NTSC coordinate of between about (0.12, 0.05) and about (0.16, 0.10), especially a NTSC coordinate of about (0.14, 0.08).

The 2H-benzotriazole compound or compounds should have a melting point above about 150°C, especially above about 200°C, more preferred above about 250°C, most preferred above about 300°C.

5



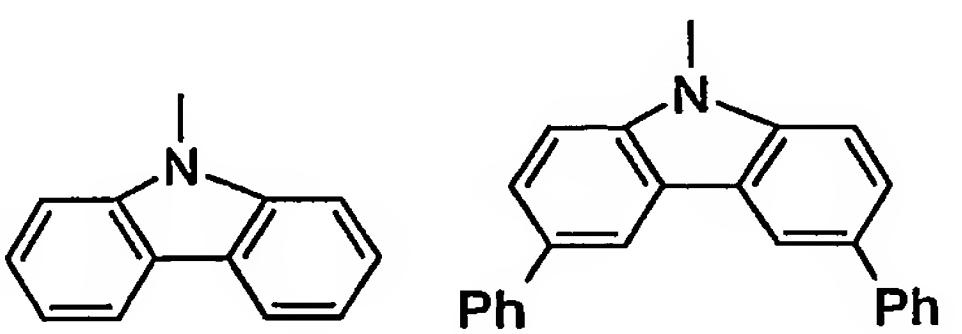
Preferably, Y³ is a group of formula



, wherein

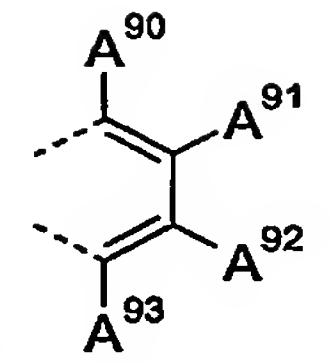
R⁴¹, R⁴², R⁴³, R⁴⁴, R⁴⁵, R⁴⁶, R⁴⁷, R⁴⁸, R⁴⁹, R⁵⁰, R⁵¹, R⁵², R⁵³, R⁵⁴, R⁵⁵, R⁵⁶, R⁵⁷, R⁵⁸, R⁵⁹, R⁶⁰,

10 R⁶¹, R⁶², R⁶³, R⁶⁴, R⁶⁵, R⁶⁶, R⁶⁷, R⁷⁰, R⁷¹, R⁷², R⁷³, R⁷⁴, R⁷⁵, R⁷⁶, R⁷⁷, R⁸⁰, R⁸¹, R⁸², R⁸³, R⁸⁴, R⁸⁵, R⁸⁶, and R⁸⁷ are independently of each other H, fluorine, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, -NR²⁵R²⁶, C₁-C₂₄alkyl, which is optionally substituted by E and/or interrupted by D, C₁-C₂₄alkenyl, which is optionally substituted by E, C₅-C₁₂cycloalkyl, which is optionally substituted by G, C₅-C₁₂cycloalkoxy, which is optionally substituted by G, C₆-C₁₈aryl, which is optionally substituted by G, C₁-C₂₄alkoxy, which is optionally substituted by E and/or interrupted by D, C₆-C₁₈aryloxy, which is optionally substituted by G, C₇-C₁₈arylalkoxy, which is optionally substituted by G, C₁-C₂₄alkylthio, which is optionally substituted by E and/or interrupted by D, C₂-C₂₀heteroaryl which is substituted by G, or C₆-C₁₈aralkyl, which is optionally substituted by G, or

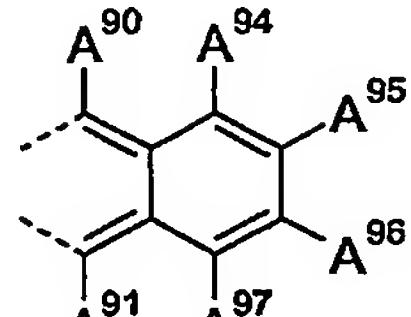


20 R⁴³, R⁶⁵ or R⁵² are a group of formula

two groups R⁴¹, R⁴², R⁴³, R⁴⁴, R⁴⁵, R⁴⁶, R⁴⁷, R⁴⁸, R⁴⁹, R⁵⁰, R⁵¹, R⁵², R⁵³, R⁵⁴, R⁵⁵, R⁵⁶, R⁵⁷, R⁵⁸, R⁵⁹, R⁶⁰, R⁶¹, R⁶², R⁶³, R⁶⁴, R⁶⁵, R⁶⁶, R⁶⁷, R⁷⁰, R⁷¹, R⁷², R⁷³, R⁷⁴, R⁷⁵, R⁷⁶, R⁷⁷, R⁸⁰, R⁸¹, R⁸²,



R^{83} , R^{84} , R^{85} , R^{86} , and R^{87} , which are neighbouring to each other, are a group



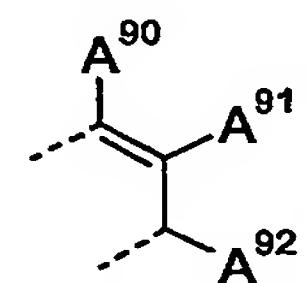
or , wherein A^{90} , A^{91} , A^{92} , A^{93} , A^{94} , A^{95} , A^{96} and A^{97} are independently of each other H, halogen, especially fluorine, $-NR^{25}R^{28}$, hydroxy, C_1-C_{24} alkyl, C_1-C_{24} alkyl which is substituted by E and/or interrupted by D, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially

5 pentafluorophenyl, C_5-C_{12} cycloalkyl, C_5-C_{12} cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or $-NR^{25}-$, C_5-C_{12} cycloalkoxy, C_5-C_{12} cycloalkoxy which is substituted by G, C_6-C_{24} aryl, C_6-C_{24} aryl which is substituted by G, C_2-C_{20} heteroaryl, C_2-C_{20} heteroaryl which is substituted by G, C_2-C_{24} alkenyl, C_2-C_{24} alkynyl, C_1-C_{24} alkoxy, C_1-C_{24} alkoxy which is substituted by E and/or interrupted by D, C_7-C_{25} aralkyl, C_7-C_{25} aralkyl, which is substituted by,

10 G, C_7-C_{25} aralkoxy, C_7-C_{25} aralkoxy which is substituted by G, or $-CO-R^{28}$, R^{68} , R^{69} , R^{78} , R^{79} , R^{88} and R^{89} are independently of each other C_1-C_{18} alkyl, C_1-C_{24} alkyl which is substituted by E and/or interrupted by D, C_6-C_{24} aryl, C_6-C_{24} aryl which is substituted by G, C_2-C_{20} heteroaryl, C_2-C_{20} heteroaryl which is substituted by G, C_2-C_{24} alkenyl, C_2-C_{24} alkynyl, C_1-C_{24} alkoxy, C_1-C_{24} alkoxy which is substituted by E and/or interrupted by D, or C_7-

15 C_{25} aralkyl, or

R^{68} and R^{69} , R^{78} and R^{79} , and/or R^{88} and R^{89} form a ring, especially a five- or six-membered ring, or

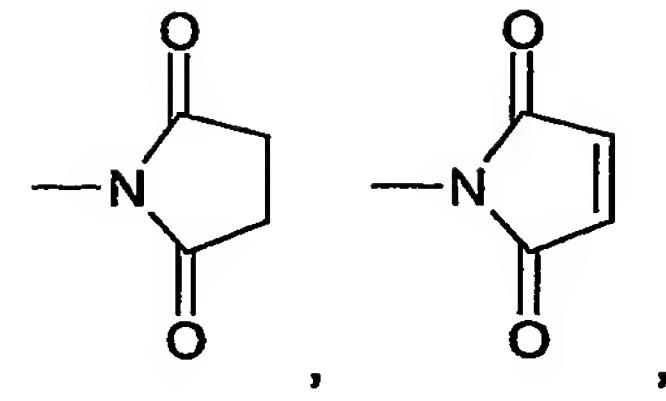


R^{68} and R^{70} , R^{69} and R^{73} , R^{77} and R^{78} and/or R^{84} and R^{89} are a group

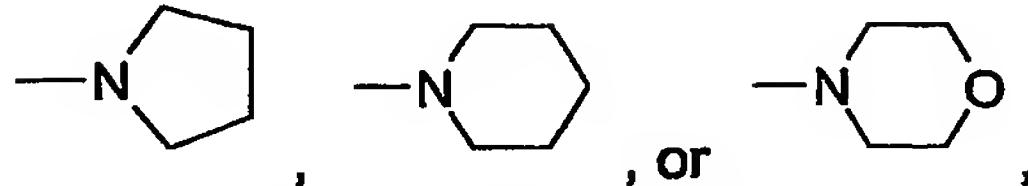
D is $-CO-$; $-COO-$; $-S-$; $-SO-$; $-SO_2-$; $-O-$; $-NR^{25}-$; $-SiR^{30}R^{31}-$; $-POR^{32}-$; $-CR^{23}=CR^{24}-$; or $-C\equiv C-$; 20 and

E is $-OR^{29}$; $-SR^{29}$; $-NR^{25}R^{26}$; $-COR^{28}$; $-COOR^{27}$; $-CONR^{25}R^{26}$; $-CN$; $-OCOOR^{27}$; or halogen; G is E, or C_1-C_{24} alkyl; wherein

25 R^{23} , R^{24} , R^{25} and R^{26} are independently of each other H; C_6-C_{18} aryl; C_6-C_{18} aryl which is substituted by C_1-C_{24} alkyl, or C_1-C_{24} alkoxy; C_1-C_{24} alkyl; or C_1-C_{24} alkyl which is interrupted by $-O-$; or



R^{25} and R^{26} together form a five or six membered ring, in particular

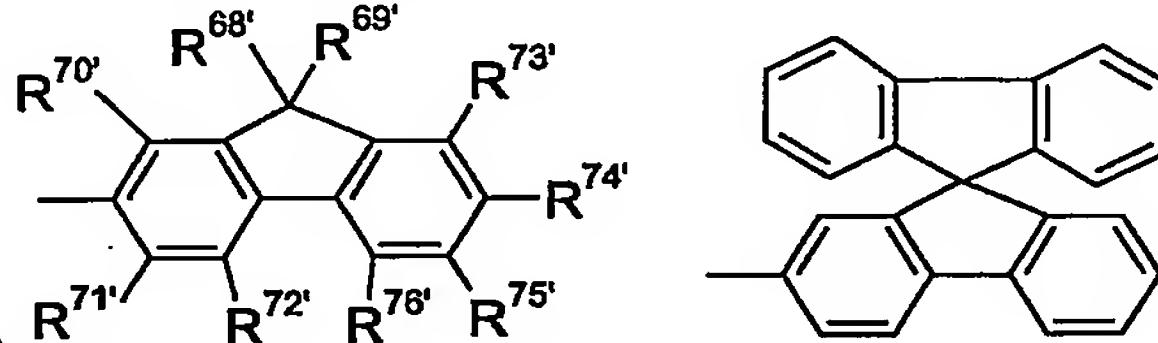


R^{27} and R^{28} are independently of each other H; C₆-C₁₈aryl; C₆-C₁₈aryl which is substituted by C₁-C₂₄alkyl, or C₁-C₂₄alkoxy; C₁-C₂₄alkyl; or C₁-C₂₄alkyl which is interrupted by -O-,

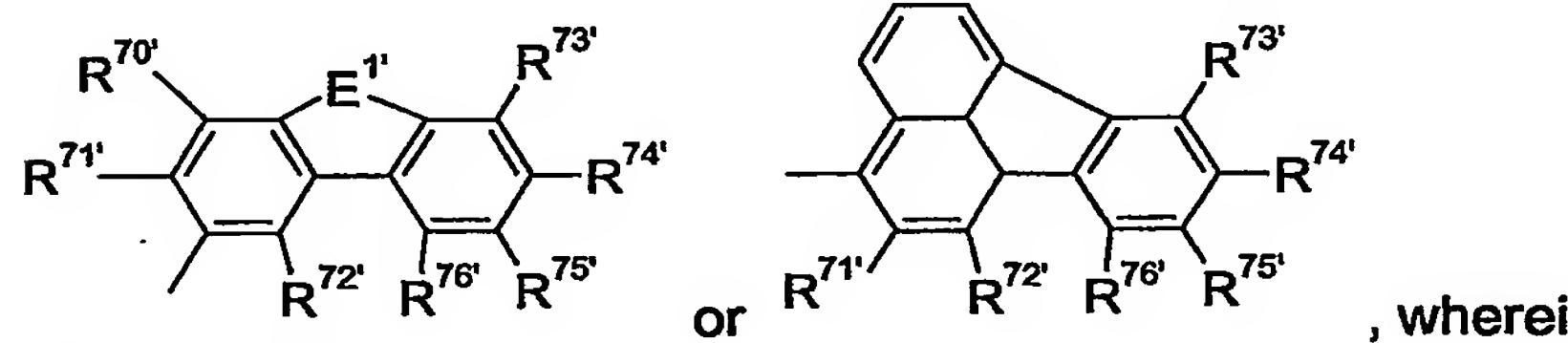
5 R^{29} is H; C₆-C₁₈aryl; C₆-C₁₈aryl, which is substituted by C₁-C₂₄alkyl, or C₁-C₂₄alkoxy; C₁-C₂₄alkyl; or C₁-C₂₄alkyl which is interrupted by -O-,

R^{30} and R^{31} are independently of each other C₁-C₂₄alkyl, C₆-C₁₈aryl, or C₆-C₁₈aryl, which is substituted by C₁-C₂₄alkyl, and

R^{32} is C₁-C₂₄alkyl, C₆-C₁₈aryl, or C₆-C₁₈aryl, which is substituted by C₁-C₂₄alkyl, or



10 R^{43} is a group of formula



, wherein

$R^{68'}$ and $R^{69'}$ are independently of each other C₁-C₂₄alkyl, especially C₁-C₁₂alkyl, which can be interrupted by one or two oxygen atoms,

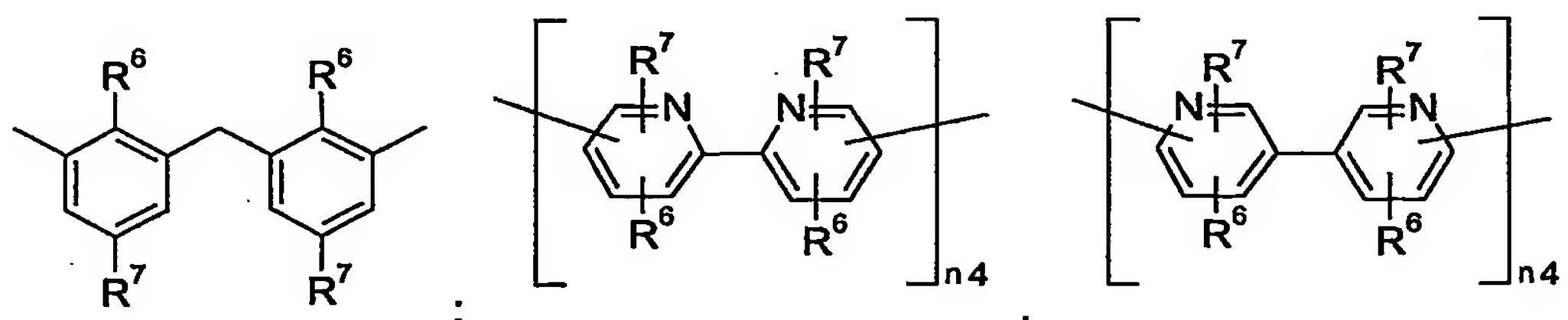
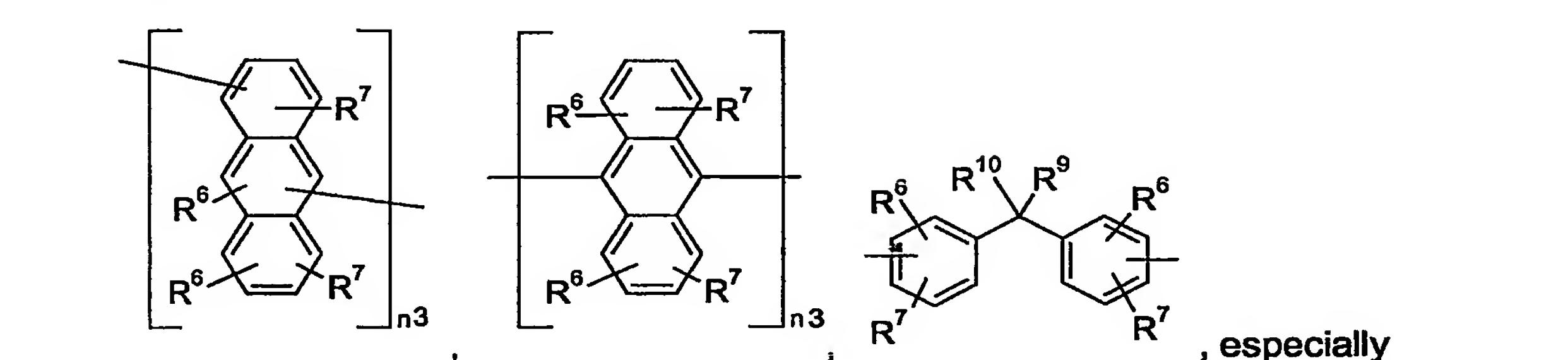
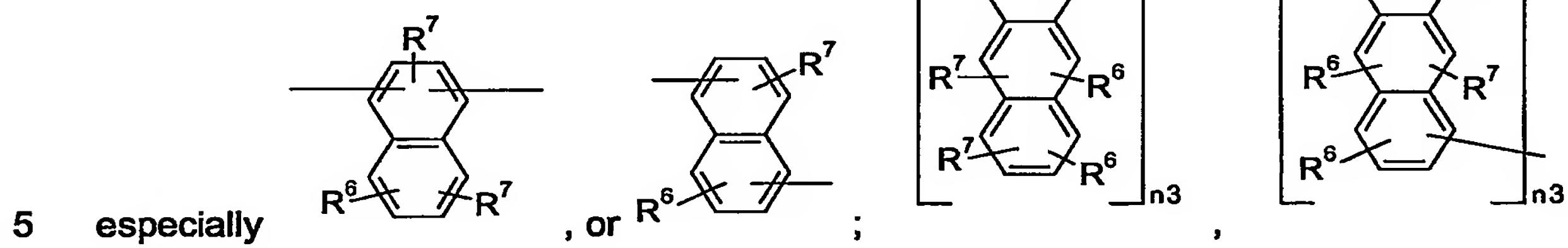
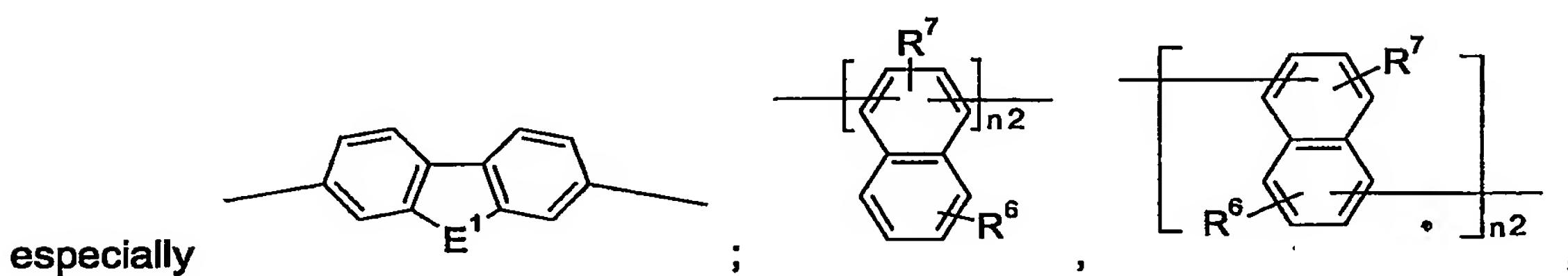
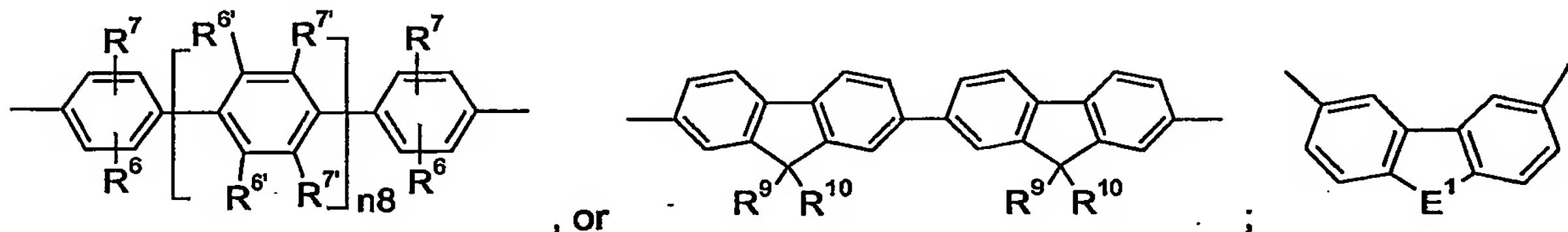
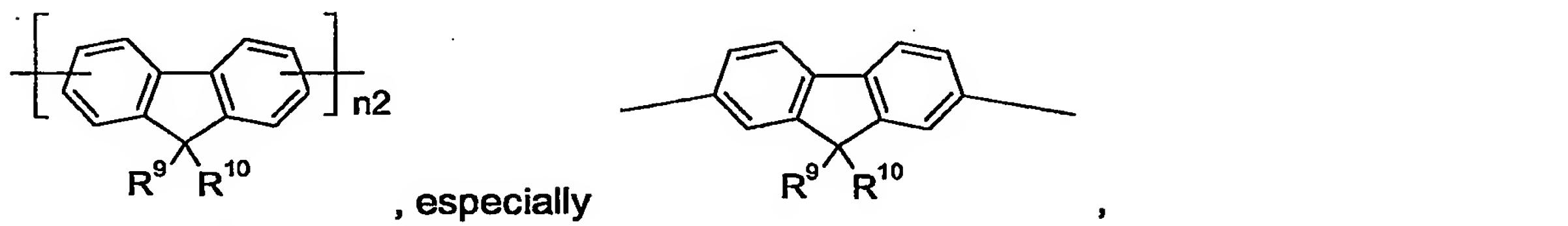
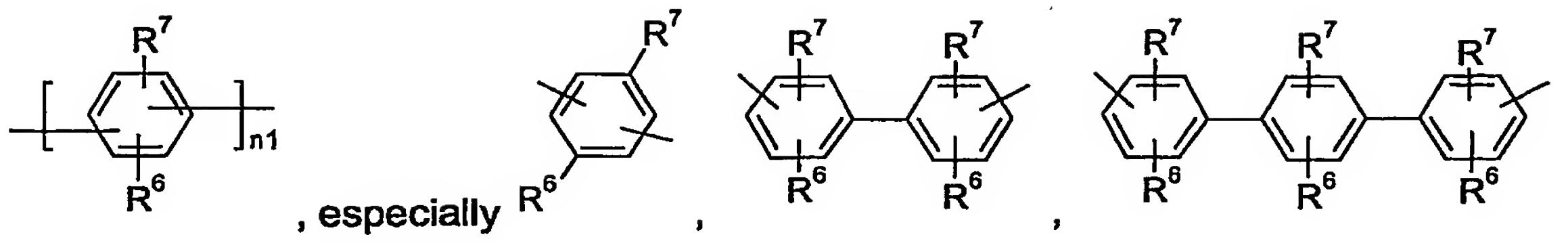
15 $R^{70'}$, $R^{71'}$, $R^{72'}$, $R^{73'}$, $R^{74'}$, $R^{75'}$ and $R^{76'}$ are independently of each other H, CN, C₁-C₂₄alkyl, C₆-C₁₀aryl, C₁-C₂₄alkoxy, C₁-C₂₄alkylthio, -NR^{25'}R^{26'}, -CONR^{25'}R^{26'}, or -COOR^{27'},

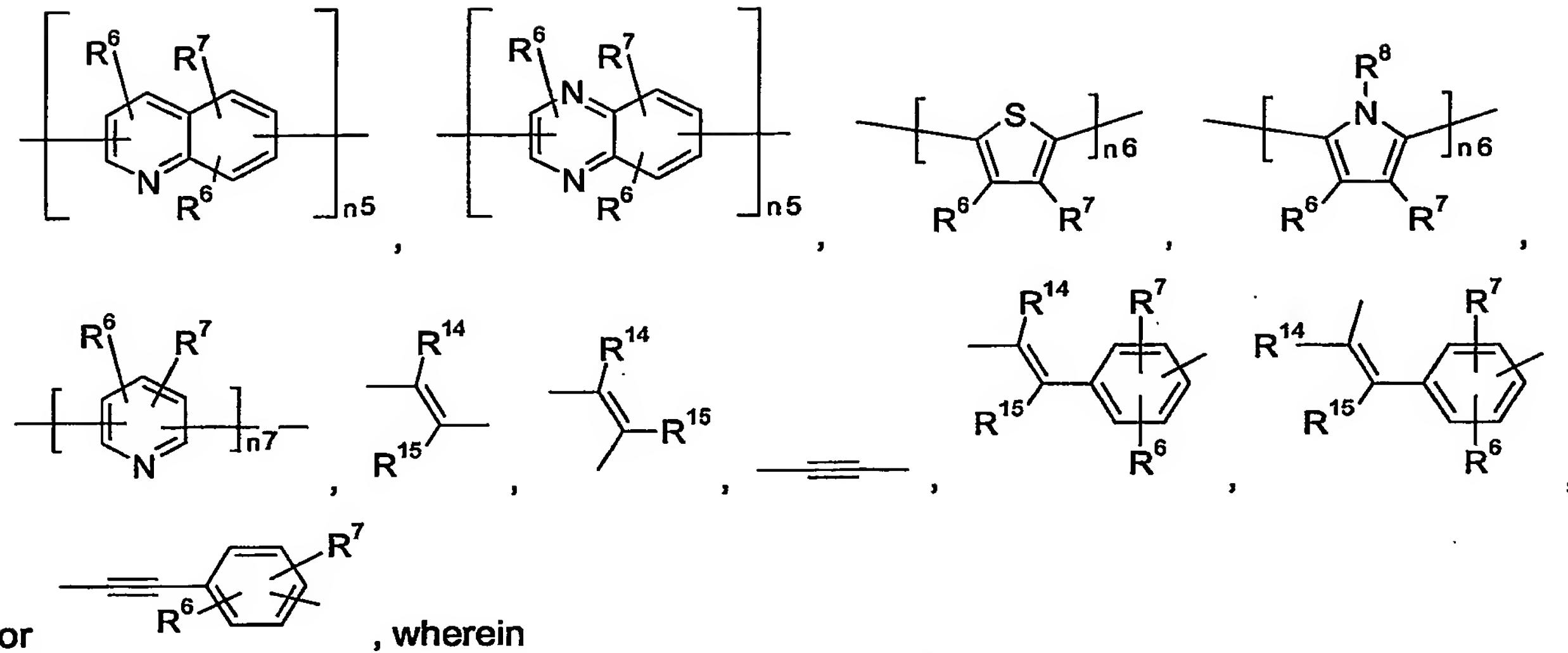
$R^{25'}$ and $R^{26'}$ are independently of each other H, C₆-C₁₈aryl, C₇-C₁₈aralkyl, or C₁-C₂₄alkyl, and $R^{27'}$ is C₁-C₂₄alkyl; and

E^1 is -S-, -O-, or -NR^{25'}-, wherein $R^{25'}$ is C₁-C₂₄alkyl, or C₆-C₁₀aryl.

20 Y^1 is preferably a group of formula

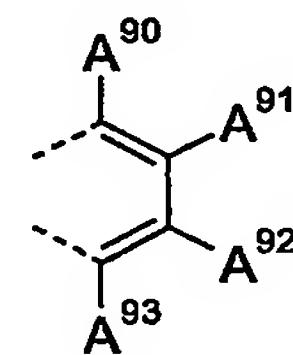
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n1, n2, n3, n4, n5, n6, n7 and n8 are 1, 2, or 3, in particular 1,

5 E¹ is -S-, -O-, or -NR²⁵-, wherein R²⁵ is C₁-C₂₄alkyl, or C₆-C₁₀aryl,
R⁶ and R⁷ are independently of each other H, halogen, especially fluorine, -NR²⁵R²⁶, hydroxy,
C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-
C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-
C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-
10 C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is
substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl,
C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D,
C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which
is substituted by G, or -CO-R²⁸,



15 R⁶ and R⁷ have the meaning of R⁶, or together form a group , wherein A⁹⁰, A⁹¹,
A⁹², and A⁹³ are independently of each other H, halogen, hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl
which is substituted by E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl,
especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G
and/or interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is
20 substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-
C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-
C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl,
which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by E, or -CO-
R²⁸,

R^8 is $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkyl}$ which is substituted by E and/or interrupted by D , $C_6\text{-}C_{24}\text{aryl}$, or $C_7\text{-}C_{25}\text{aralkyl}$,

R^9 and R^{10} are independently of each other $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkyl}$ which is substituted by E and/or interrupted by D , $C_6\text{-}C_{24}\text{aryl}$, $C_6\text{-}C_{24}\text{aryl}$ which is substituted by G , $C_2\text{-}C_{20}\text{heteroaryl}$,

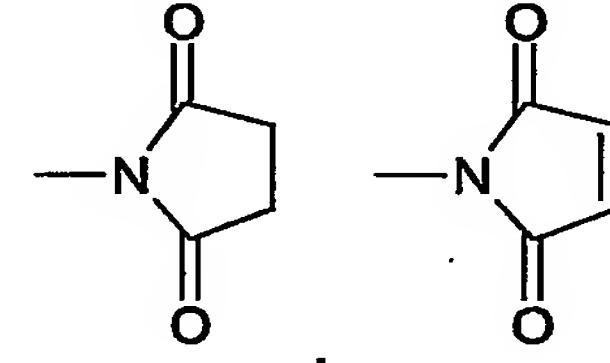
5 $C_2\text{-}C_{20}\text{heteroaryl}$ which is substituted by G , $C_2\text{-}C_{24}\text{alkenyl}$, $C_2\text{-}C_{24}\text{alkynyl}$, $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkoxy}$ which is substituted by E and/or interrupted by D , or $C_7\text{-}C_{25}\text{aralkyl}$, or R^9 and R^{10} form a ring, especially a five- or six-membered ring,

R^{14} and R^{15} are independently of each other H , $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkyl}$ which is substituted by E and/or interrupted by D , $C_6\text{-}C_{24}\text{aryl}$, $C_6\text{-}C_{24}\text{aryl}$ which is substituted by G , $C_2\text{-}C_{20}\text{heteroaryl}$, or $C_2\text{-}C_{20}\text{heteroaryl}$ which is substituted by G ,

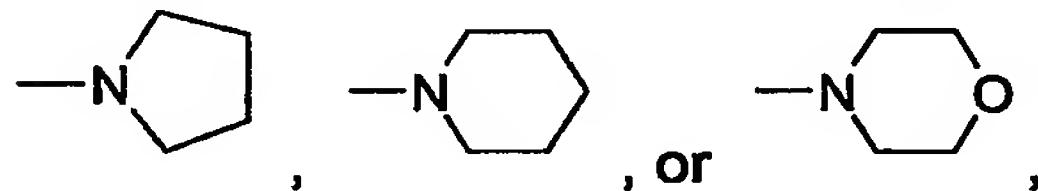
10 D is $-\text{CO}-$, $-\text{COO}-$, $-\text{S}-$, $-\text{SO}-$, $-\text{SO}_2-$, $-\text{O}-$, $-\text{NR}^{25}-$, $-\text{SiR}^{30}\text{R}^{31}-$, $-\text{POR}^{32}-$, $-\text{CR}^{23}=\text{CR}^{24}-$, or $-\text{C}\equiv\text{C}-$, G is E , or $C_1\text{-}C_{24}\text{alkyl}$, and

E is $-\text{OR}^{29}$, $-\text{SR}^{29}$, $-\text{NR}^{25}\text{R}^{26}$, $-\text{COR}^{28}$, $-\text{COOR}^{27}$, $-\text{CONR}^{25}\text{R}^{26}$, $-\text{CN}$, $-\text{OCOOR}^{27}$, or halogen, wherein

15 R^{23} , R^{24} , R^{25} and R^{26} are independently of each other H , $C_6\text{-}C_{18}\text{aryl}$, $C_6\text{-}C_{18}\text{aryl}$ which is substituted by $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkyl}$, or $C_1\text{-}C_{24}\text{alkyl}$ which is interrupted by $-\text{O}-$, or



R^{25} and R^{26} together form a five or six membered ring, in particular

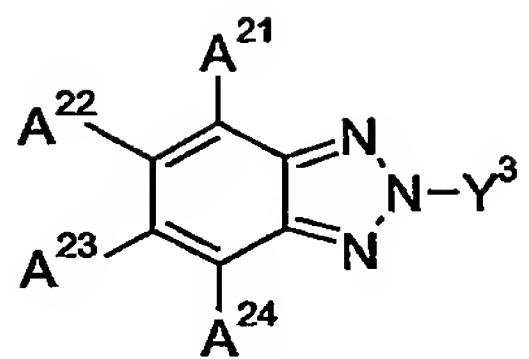


20 R^{27} and R^{28} are independently of each other H , $C_6\text{-}C_{18}\text{aryl}$, $C_6\text{-}C_{18}\text{aryl}$ which is substituted by $C_1\text{-}C_{24}\text{alkyl}$, or $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkyl}$, or $C_1\text{-}C_{24}\text{alkyl}$ which is interrupted by $-\text{O}-$, R^{29} is H , $C_6\text{-}C_{18}\text{aryl}$, $C_6\text{-}C_{18}\text{aryl}$, which is substituted by $C_1\text{-}C_{24}\text{alkyl}$, $C_1\text{-}C_{24}\text{alkoxy}$, $C_1\text{-}C_{24}\text{alkyl}$, or $C_1\text{-}C_{24}\text{alkyl}$ which is interrupted by $-\text{O}-$,

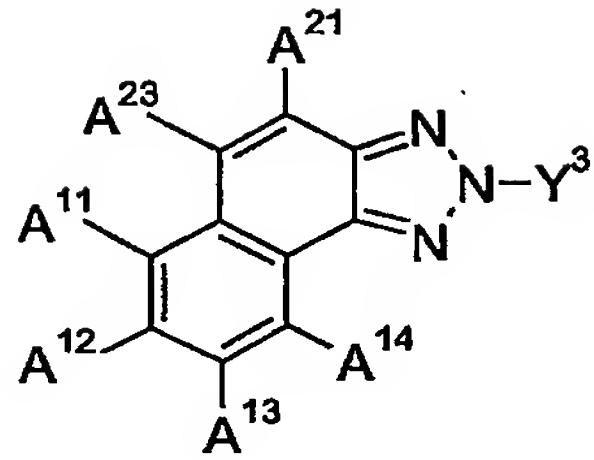
R^{30} and R^{31} are independently of each other $C_1\text{-}C_{24}\text{alkyl}$, $C_6\text{-}C_{18}\text{aryl}$, or $C_6\text{-}C_{18}\text{aryl}$, which is substituted by $C_1\text{-}C_{24}\text{alkyl}$, and

25 R^{32} is $C_1\text{-}C_{24}\text{alkyl}$, $C_6\text{-}C_{18}\text{aryl}$, or $C_6\text{-}C_{18}\text{aryl}$, which is substituted by $C_1\text{-}C_{24}\text{alkyl}$.

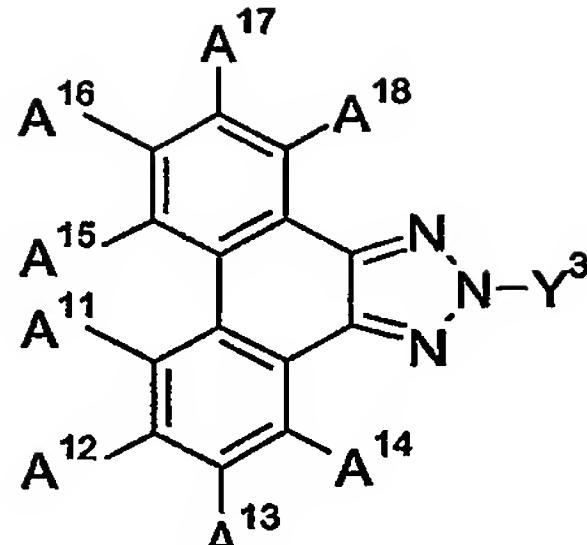
In a preferred embodiment the present invention is directed to 2H-benzotriazole compounds of formula



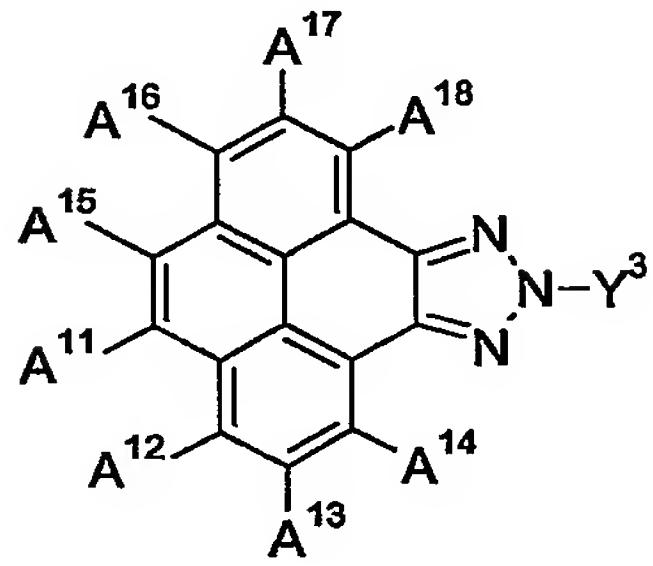
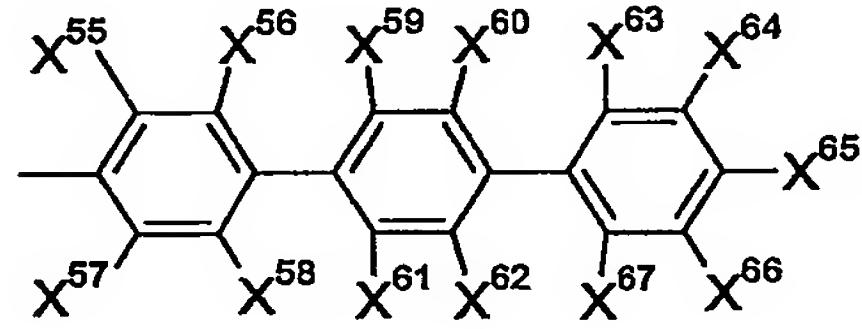
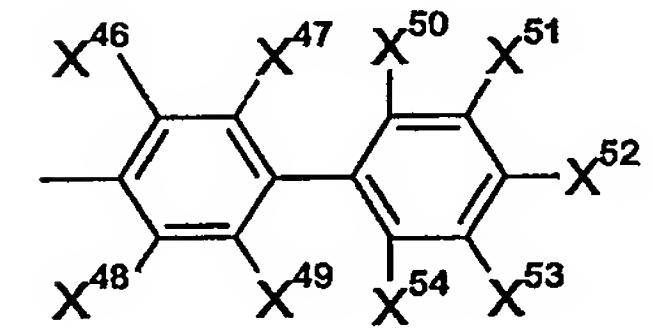
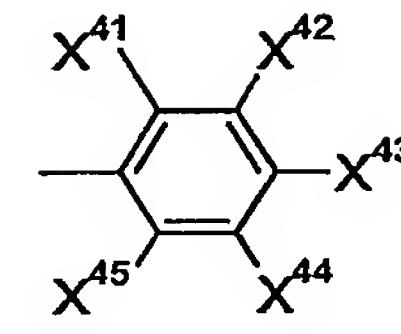
(Ia),



(Ib),

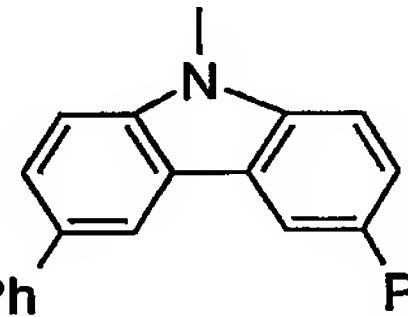
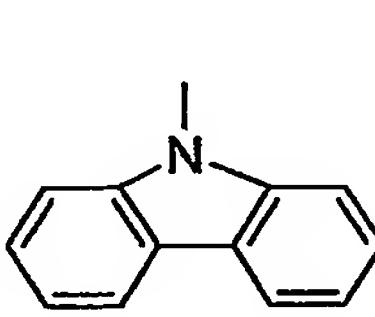


(Ic), or

(Id), wherein A¹² or A²³ are a group of formula

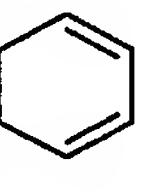
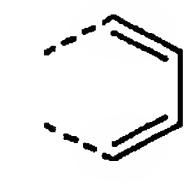
, wherein X⁴¹, X⁴², X⁴³, X⁴⁴, X⁴⁵,

X⁴⁶, X⁴⁷, X⁴⁸, X⁴⁹, X⁵⁰, X⁵¹, X⁵², X⁵³, X⁵⁴, X⁵⁵, X⁵⁶, X⁵⁷, X⁵⁸, X⁵⁹, X⁶⁰, X⁶¹, X⁶², X⁶³, X⁶⁴, X⁶⁵, X⁶⁶ and X⁶⁷ are independently of each other and independently of each other H, fluorine, CN, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₁-C₂₄haloalkyl, C₆-C₁₀aryl, which can optionally be substituted by one, or more C₁-C₈alkyl, or C₁-C₈alkoxy groups; C₁-C₂₄alkoxy, C₁-C₂₄alkylthio, -NR²⁵R²⁶, -CONR²⁵R²⁶, or -COOR²⁷, or



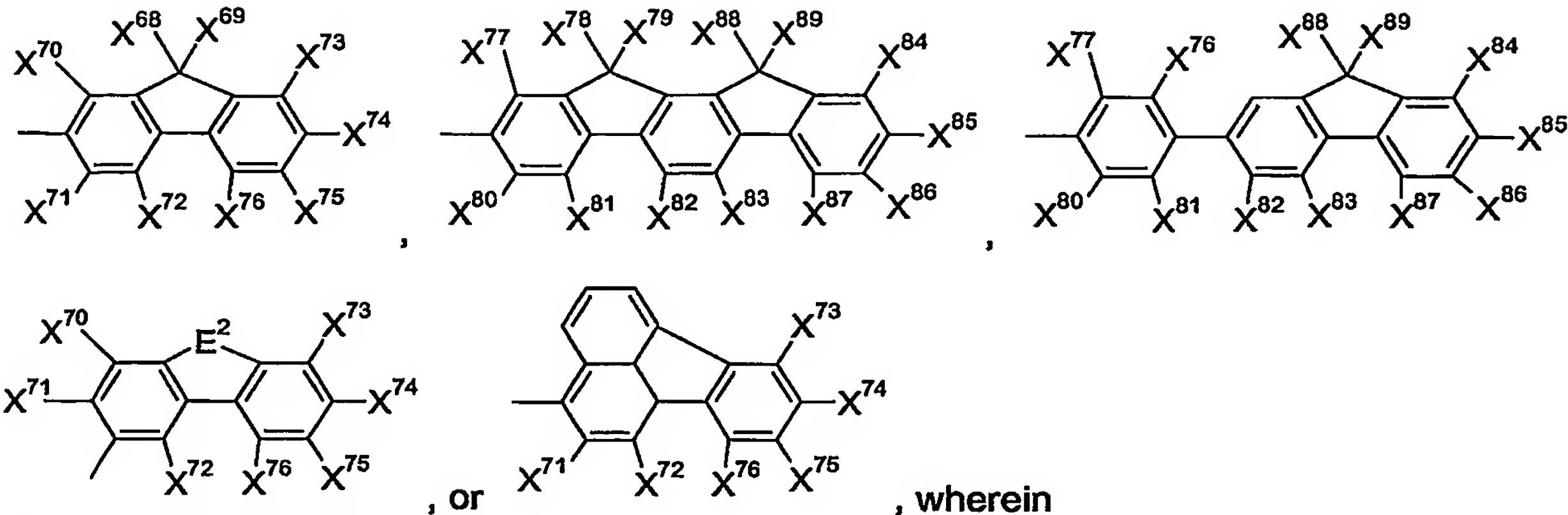
10 X⁴³, X⁶⁵ or X⁵² are a group of formula

two groups X⁴¹, X⁴², X⁴³, X⁴⁴, X⁴⁵, X⁴⁶, X⁴⁷, X⁴⁸, X⁴⁹, X⁵⁰, X⁵¹, X⁵², X⁵³, X⁵⁴, X⁵⁵, X⁵⁶, X⁵⁷, X⁵⁸, X⁵⁹, X⁶⁰, X⁶¹, X⁶², X⁶³, X⁶⁴, X⁶⁵, X⁶⁶ and X⁶⁷, which are neighbouring to each other, are a group



, or , wherein preferably at least one of the substituents X⁴¹, X⁴², X⁴³, X⁴⁴, X⁴⁵, X⁴⁶, X⁴⁷, X⁴⁸, X⁴⁹, X⁵⁰, X⁵¹, X⁵², X⁵³, X⁵⁴, X⁵⁵, X⁵⁶, X⁵⁷, X⁵⁸, X⁵⁹, X⁶⁰, X⁶¹, X⁶², X⁶³, X⁶⁴, X⁶⁵,

15 X⁶⁶ and X⁶⁷ is fluorine, -NR²⁵R²⁶, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl, or A¹² and A²³ are a group of formula



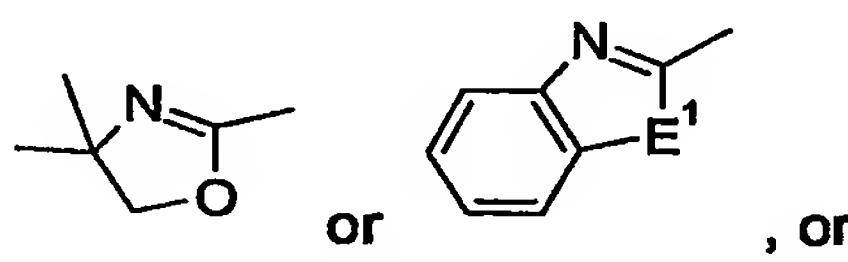
X^{68} , X^{69} , X^{78} , X^{79} , X^{88} and X^{89} are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, which can be interrupted by one or two oxygen atoms,

5 X^{70} , X^{71} , X^{72} , X^{73} , X^{74} , X^{75} , X^{76} , X^{77} , X^{80} , X^{81} , X^{82} , X^{83} , X^{84} , X^{85} , X^{86} and X^{87} are independently of each other H, CN, C_1 - C_{24} alkyl, C_6 - C_{10} aryl, which can optionally be substituted by one, or more C_1 - C_8 alkyl, or C_1 - C_8 alkoxy groups; C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$,

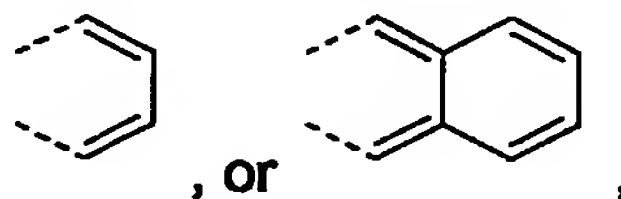
E² is $-S-$, $-O-$, or $-NR^{25}-$, wherein R²⁵ is C_1 - C_{24} alkyl, or C_6 - C_{10} aryl,

10 A²¹, A²² and A²⁴ are independently of each other hydrogen, halogen, especially fluorine, C_1 - C_{24} alkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} haloalkyl, C_6 - C_{18} aryl, which can optionally be substituted by one, or more C_1 - C_8 alkyl, or C_1 - C_8 alkoxy groups; $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or

C_2 - C_{10} heteroaryl, especially a group of formula



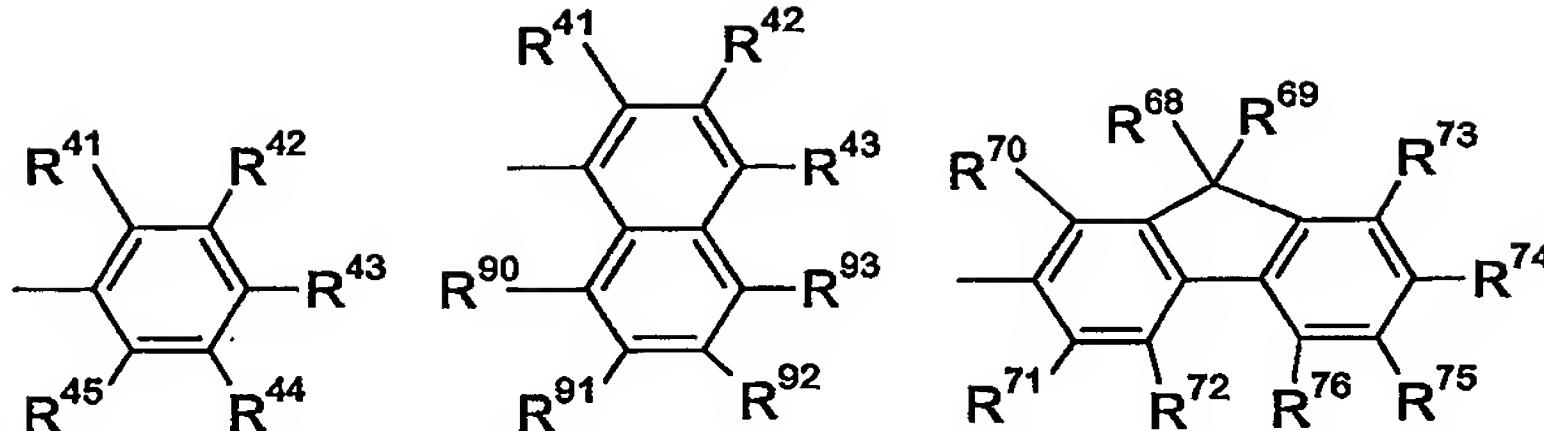
15 A²² and A²³ or A¹¹ and A²³ are a group of formula



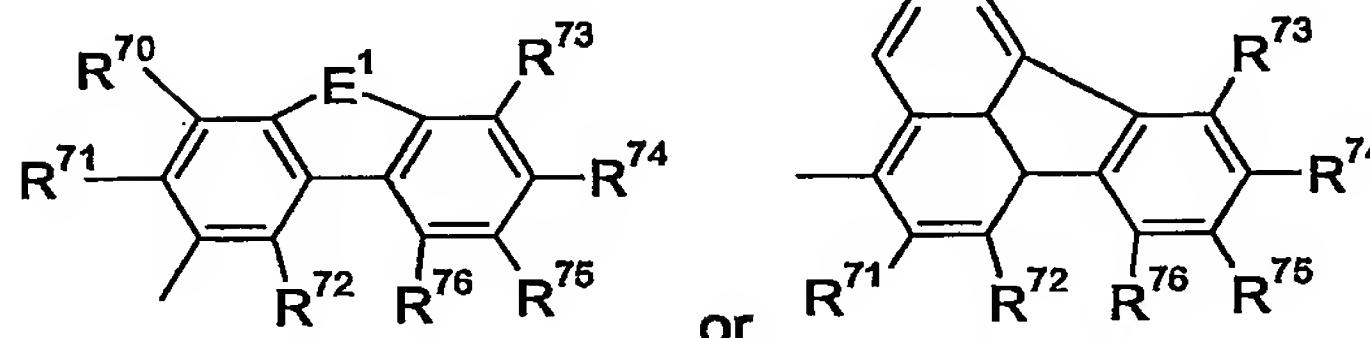
A¹¹, A¹³, A¹⁴, A¹⁵, A¹⁶, A¹⁷, and A¹⁸ are independently of each other H, CN, C_1 - C_{24} alkyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, C_1 - C_{24} haloalkyl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, C_6 - C_{18} aryl, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or C_2 - C_{10} heteroaryl, wherein

20 R²⁵ and R²⁶ are independently of each other H, C_6 - C_{18} aryl, C_7 - C_{18} aralkyl, or C_1 - C_{24} alkyl, R²⁷ is C_1 - C_{24} alkyl, and

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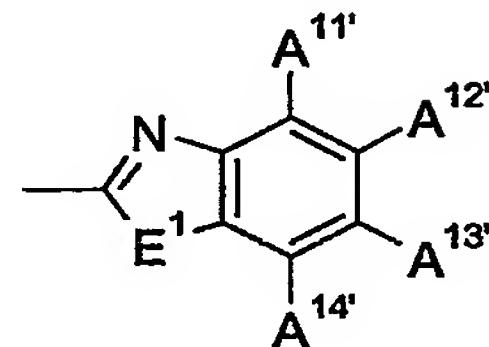
Y³ is a group of formula



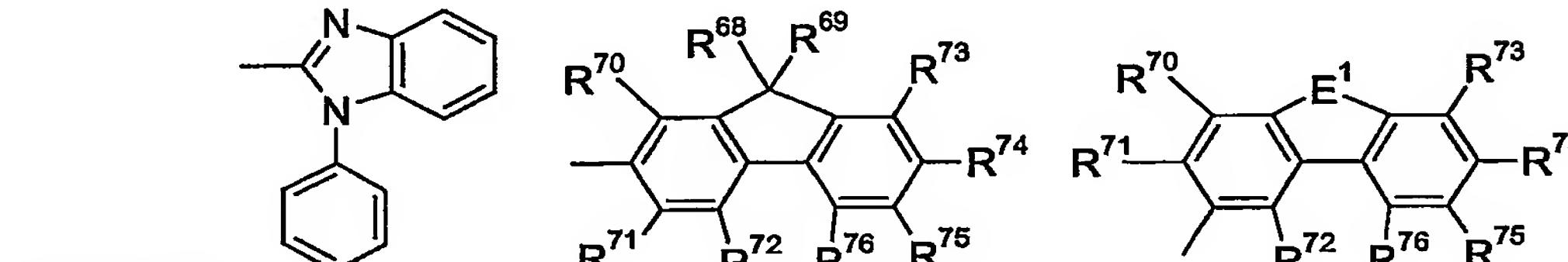
, wherein

R⁴¹ is hydrogen, C₁-C₂₄alkoxy, or -OC₇-C₁₈aralkyl,

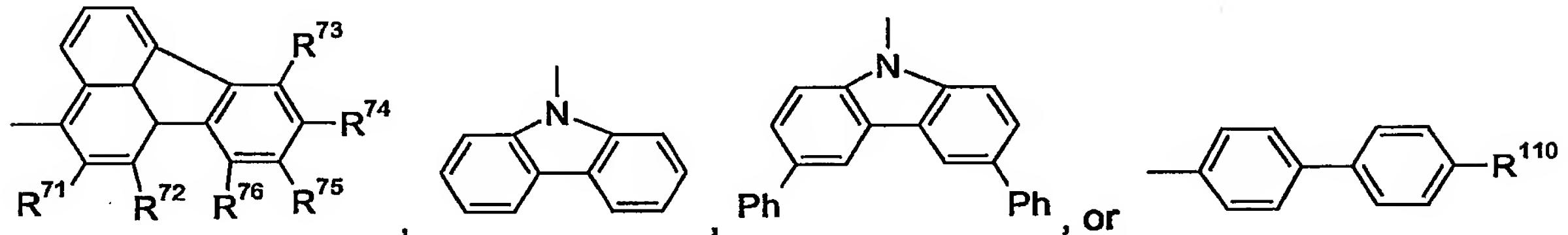
R⁴² is hydrogen, or C₁-C₂₄alkyl,



5 R⁴³ is hydrogen, halogen, -CONR²⁵R²⁶, -COOR²⁷,



especially



wherein

A¹¹, A¹², A¹³, and A¹⁴ are independently of each other H, CN, C₁-C₂₄alkyl, C₁-C₂₄alkoxy, C₁-

10 C₂₄alkylthio, -NR²⁵R²⁶, -CONR²⁵R²⁶, or -COOR²⁷,

E¹ is -S-, -O-, or -NR²⁵-, wherein R²⁵ is C₁-C₂₄alkyl, or C₆-C₁₀aryl,

R¹¹⁰ is H, CN, C₁-C₂₄alkyl, C₁-C₂₄alkoxy, C₁-C₂₄alkylthio, -NR²⁵R²⁶, -CONR²⁵R²⁶, or -COOR²⁷,

or



R⁴² and R⁴³ are a group of formula

15 R⁴⁴ is hydrogen, or C₁-C₂₄alkyl,

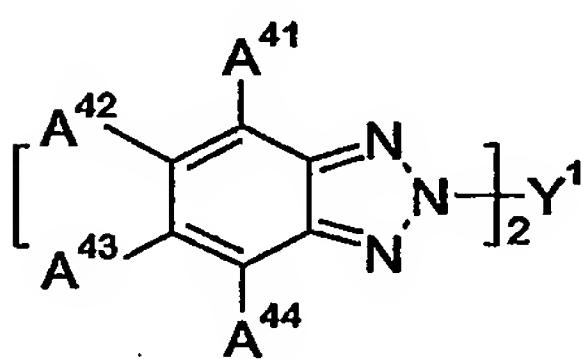
R⁴⁵ is hydrogen, or C₁-C₂₄alkyl,

R^{68} and R^{69} are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, which can be interrupted by one or two oxygen atoms,

R^{70} , R^{71} , R^{72} , R^{73} , R^{74} , R^{75} , R^{76} , R^{90} , R^{91} , R^{92} , and R^{93} are independently of each other H, CN, C_1 - C_{24} alkyl, C_6 - C_{10} aryl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$,

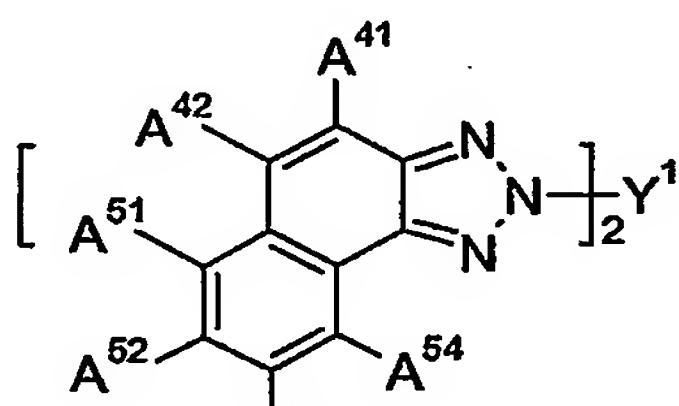
5 R^{25} and R^{26} are independently of each other H, C_6 - C_{18} aryl, C_7 - C_{18} aralkyl, or C_1 - C_{24} alkyl, and R^{27} is C_1 - C_{24} alkyl.

In a preferred embodiment the present invention is directed to 2H-benzotriazole compounds of formula

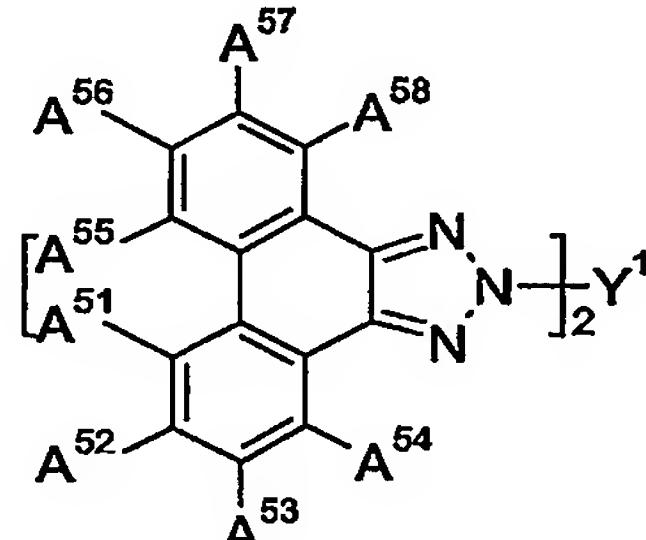


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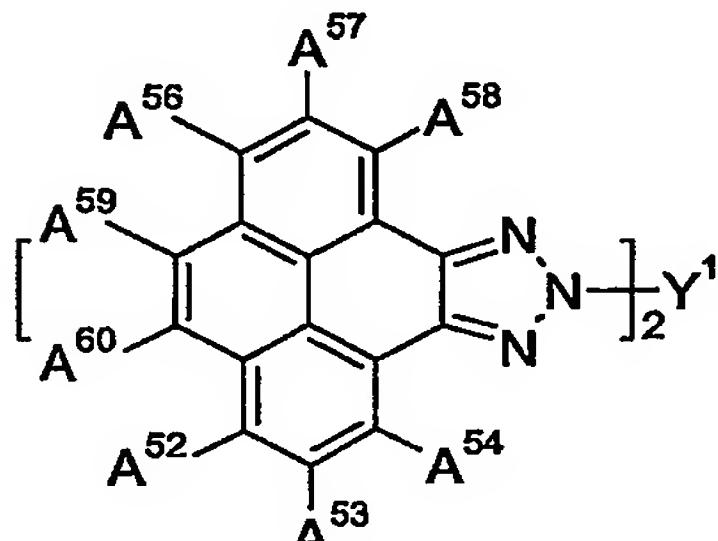
(IIa),



(IIb),

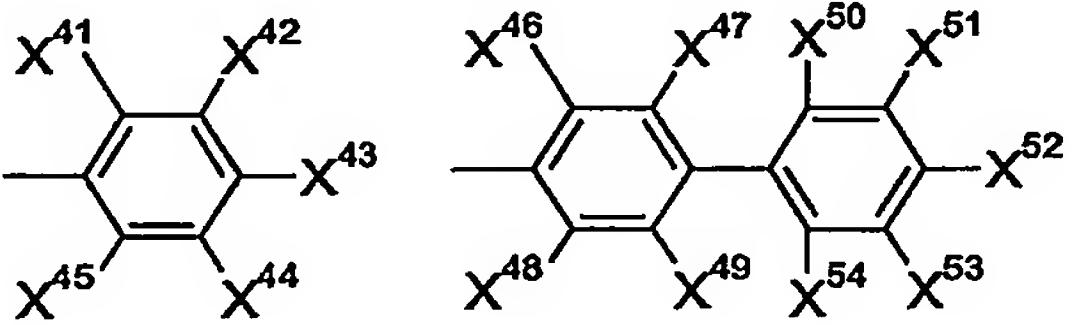
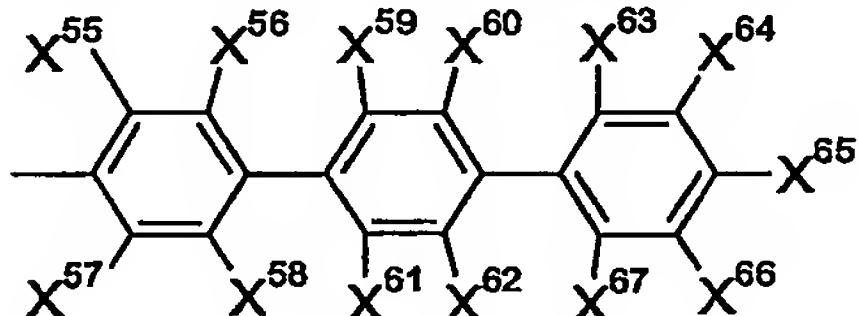


(IIc),



or

(IId), wherein

wherein A^{52} and A^{43} are a group of formula, wherein X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} are independently

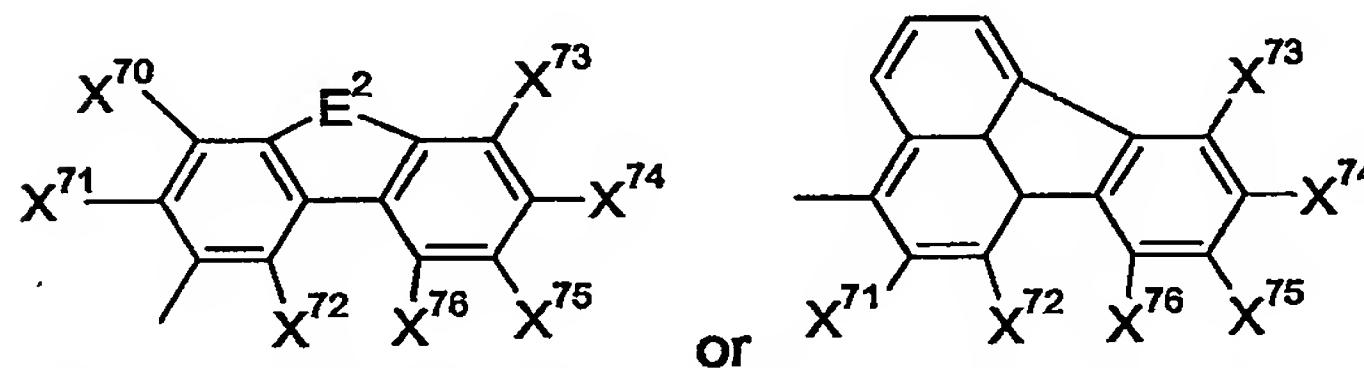
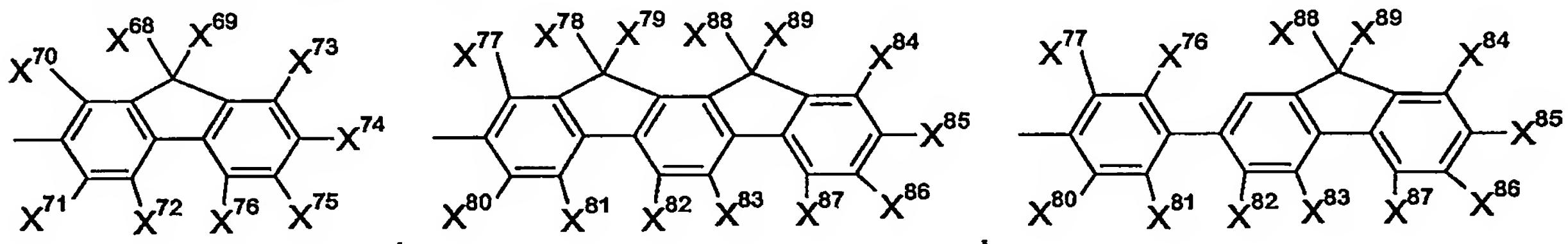
15 of each other are independently of each other H, fluorine, CN, C_1 - C_{24} alkyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, or C_1 - C_{24} haloalkyl, C_6 - C_{10} aryl, which can optionally be substituted by one, or more C_1 - C_8 alkyl, or C_1 - C_8 alkoxy groups;

 C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or

two groups X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} , which are neighbouring to each other, are a



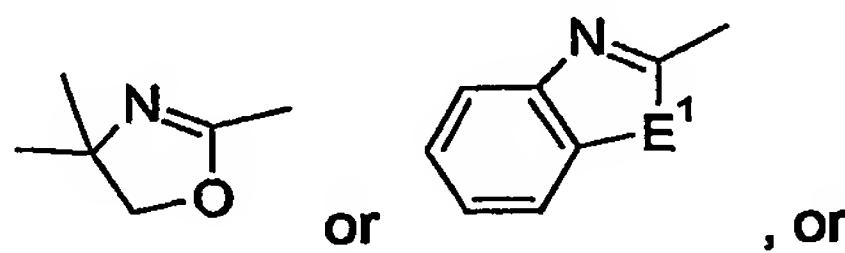
group , or , wherein preferably at least one of the substituents X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} is fluorine, $-NR^{25}R^{26}$, C_1-C_{24} alkyl, C_5-C_{12} cycloalkyl, C_7-C_{25} aralkyl, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially pentafluorophenyl, or C_1-C_{24} haloalkyl, or A^{43} or A^{52} are a group of formula



, wherein

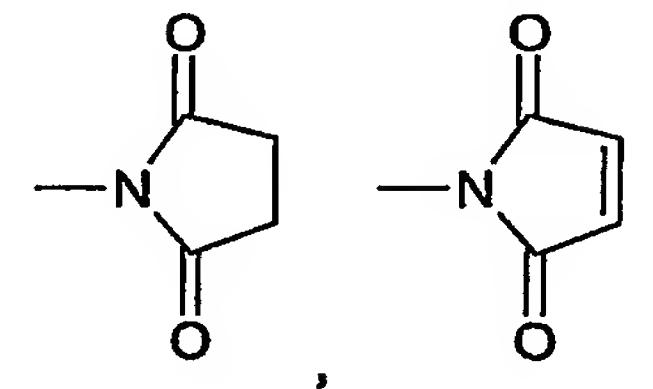
10 X^{68} , X^{69} , X^{78} , X^{79} , X^{88} and X^{89} are independently of each other C_1-C_{24} alkyl, especially C_1-C_{12} alkyl, which can be interrupted by one or two oxygen atoms, X^{70} , X^{71} , X^{72} , X^{73} , X^{74} , X^{75} , X^{76} , X^{77} , X^{80} , X^{81} , X^{82} , X^{83} , X^{84} , X^{85} , X^{86} and X^{87} are independently of each other H, CN, C_1-C_{24} alkyl, C_6-C_{10} aryl, C_1-C_{24} alkoxy, C_1-C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$,

15 E^2 is $-S-$, $-O-$, or $-NR^{25}-$, A^{41} , A^{42} and A^{44} are independently of each other hydrogen, halogen, C_1-C_{24} alkyl, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially pentafluorophenyl, C_5-C_{12} cycloalkyl, C_7-C_{25} aralkyl, C_1-C_{24} haloalkyl, C_6-C_{18} aryl, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or C_2-C_{10} heteroaryl, especially a group of formula

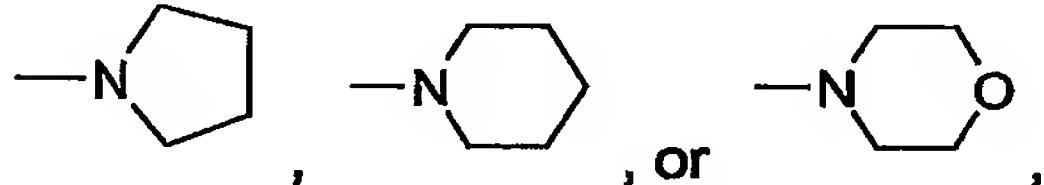


20 A^{51} , A^{53} , A^{54} , A^{55} , A^{56} , A^{57} , A^{58} , A^{59} and A^{60} are independently of each other H, fluorine, CN, C_1-C_{24} alkyl, C_1-C_{24} alkoxy, C_1-C_{24} alkylthio, C_5-C_{12} cycloalkyl, C_7-C_{25} aralkyl, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially pentafluorophenyl, C_1-C_{24} haloalkyl, C_6-C_{18} aryl, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or C_2-C_{10} heteroaryl, wherein E^1 is O, S, or $-NR^{25}-$,

R^{25} and R^{26} are independently of each other H, C₆-C₁₈aryl, C₇-C₁₈aralkyl, or C₁-C₂₄alkyl, or

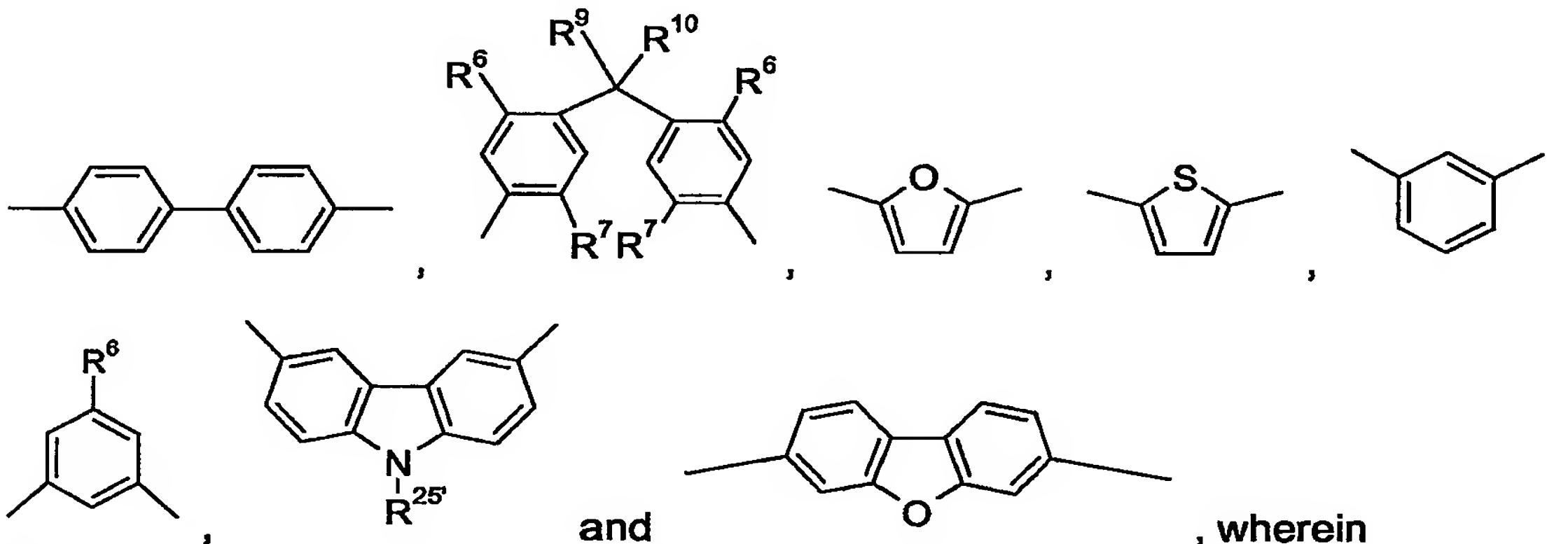


R^{25} and R^{26} together form a five or six membered ring, in particular



R^{27} is C₁-C₂₄alkyl, and

5 Y¹ is a group of formula



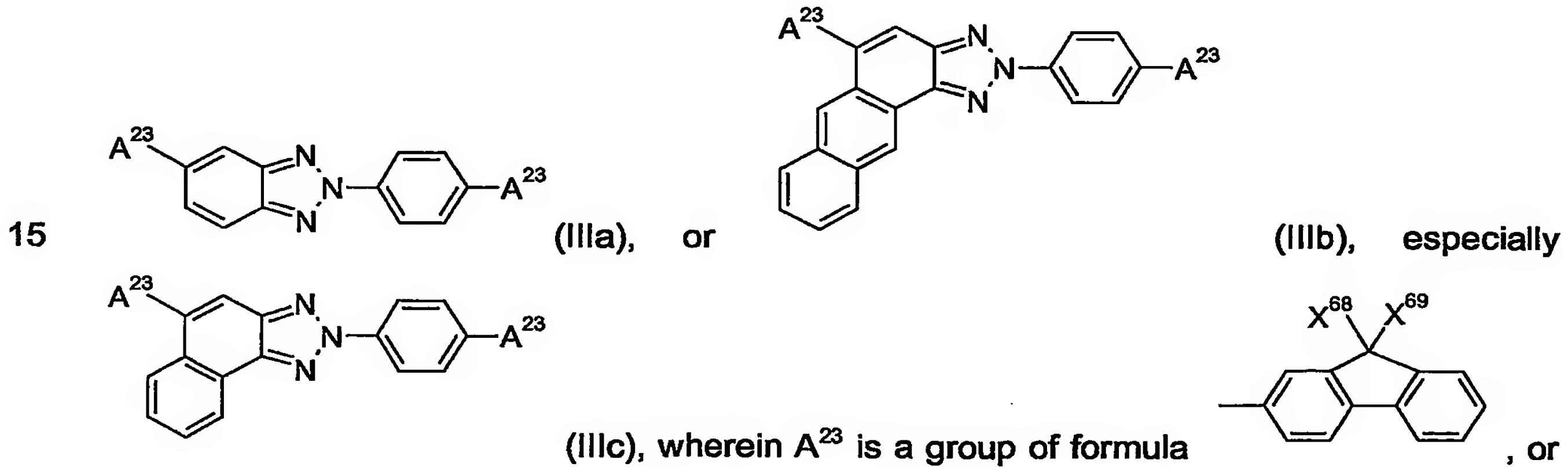
and , wherein

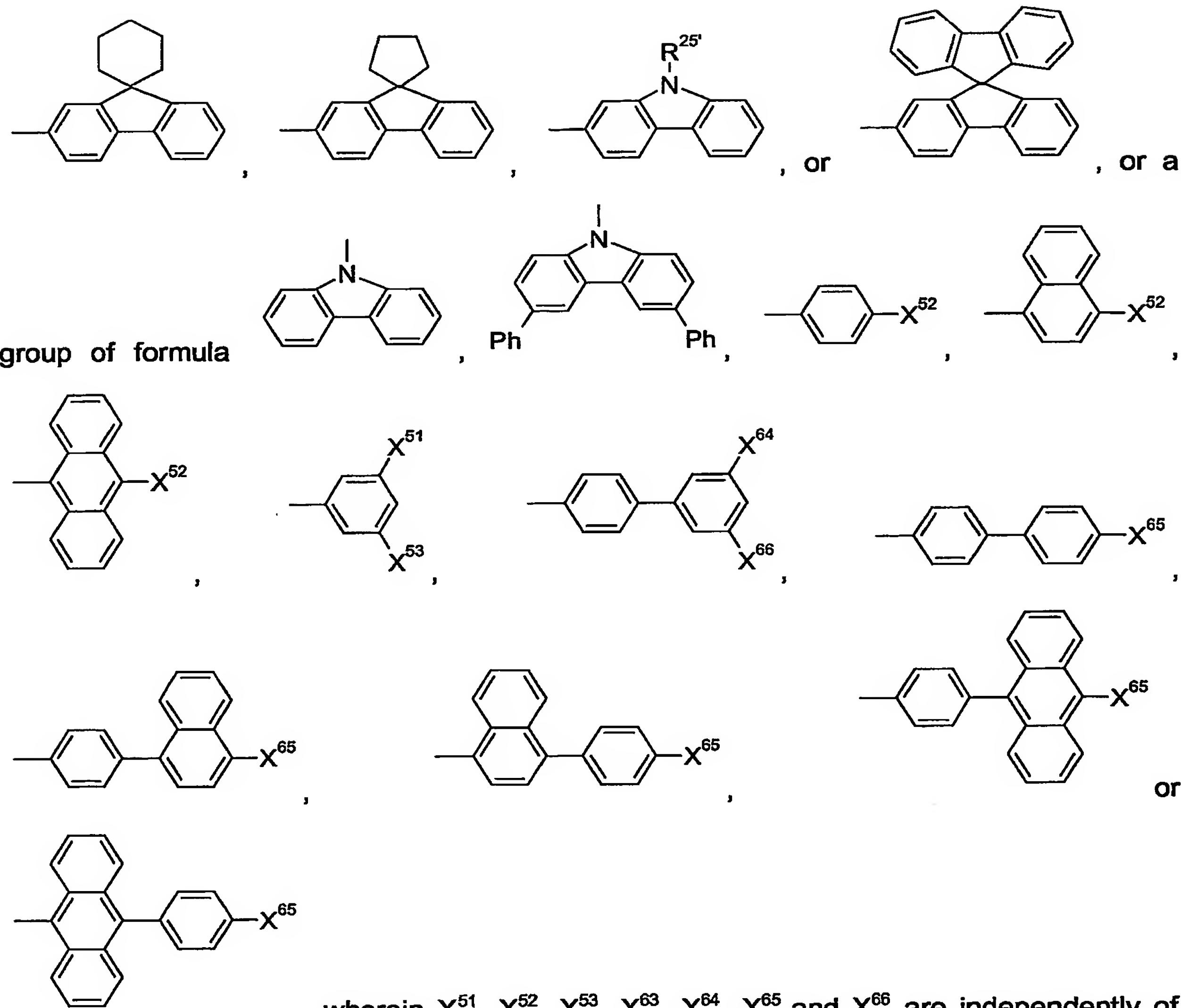
R^6 is C₁-C₂₄alkoxy, or -O-C₇-C₂₅aralkyl, R^7 is H, or C₁-C₂₄alkyl, R^9 and R^{10} are independently of each other C₁-C₂₄alkyl, especially C₄-C₁₂alkyl, which can be interrupted by one or two

10 oxygen atoms, and

$R^{25'}$ is C₁-C₂₄alkyl, or C₆-C₁₀aryl.

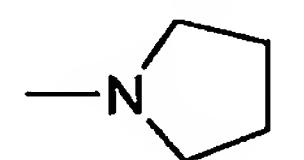
In a particular preferred embodiment the 2H-benzotriazole compound is a compound of formula

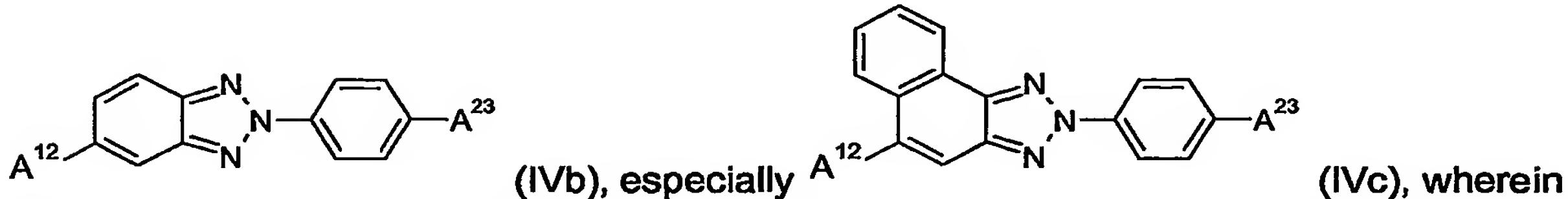
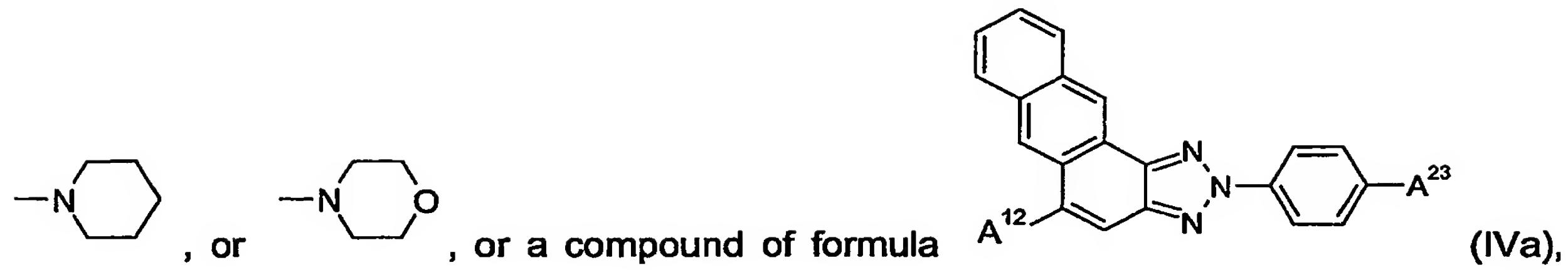




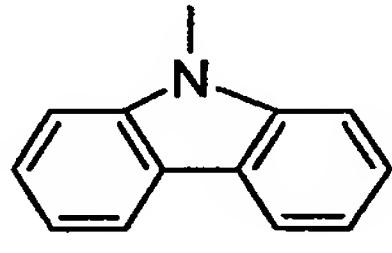
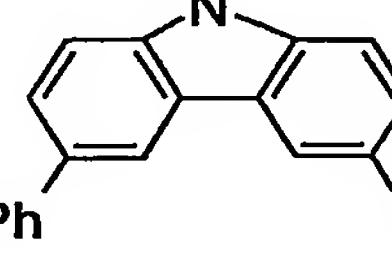
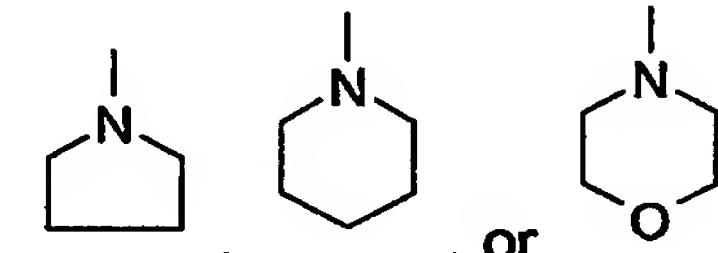
, wherein X^{51} , X^{52} , X^{53} , X^{63} , X^{64} , X^{65} and X^{66} are independently of each other fluorine, C₁-C₂₄alkyl, especially C₁-C₁₂alkyl, very especially tert-butyl, C₅-C₁₂cycloalkyl, especially cyclohexyl, which can optionally be substituted by one, or two C₁-C₈alkyl groups, or 1-adamantyl, C₁-C₂₄perfluoroalkyl, especially C₁-C₁₂perfluoroalkyl, such as CF₃, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, NR²⁵R²⁶, wherein R²⁵ and R²⁶ are C₆-C₁₄aryl, especially phenyl, which can be substituted by one, or two C₁-C₂₄alkyl groups, or R²⁵

and R²⁶ together form a five or six membered heterocyclic ring, especially



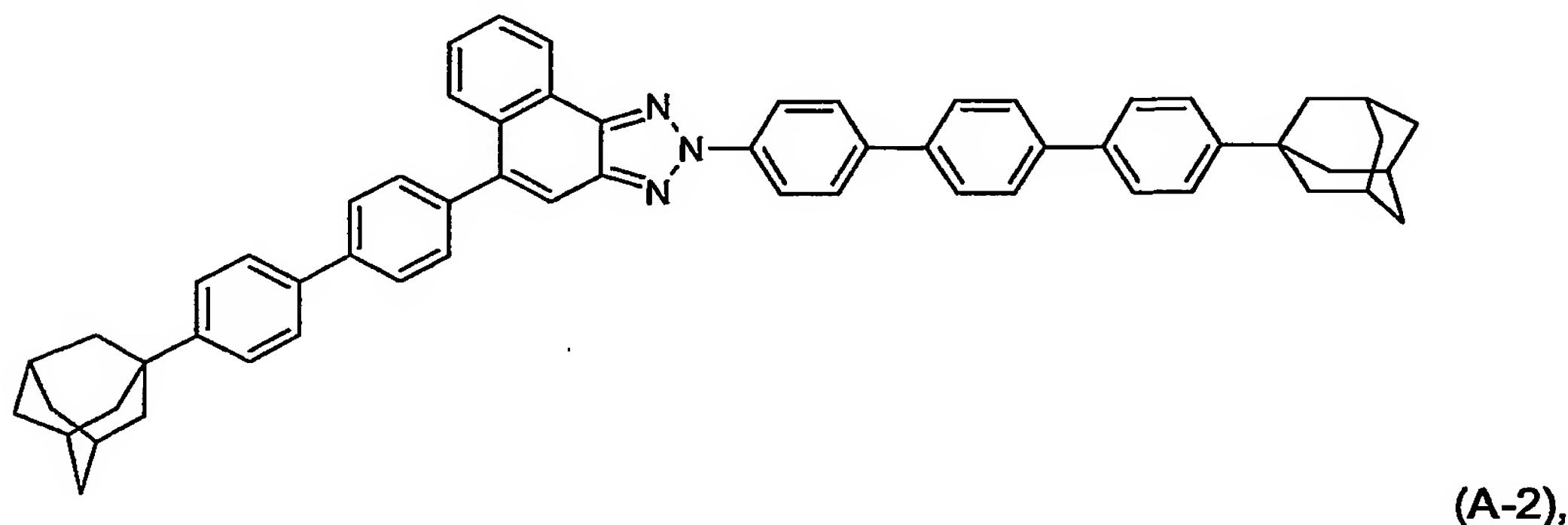
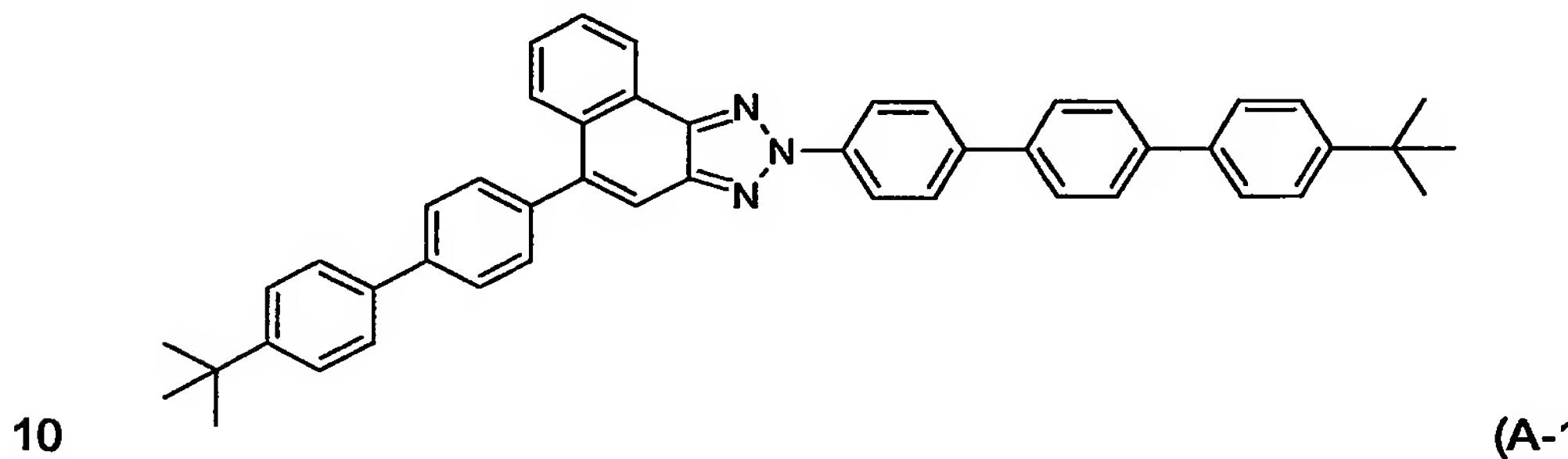


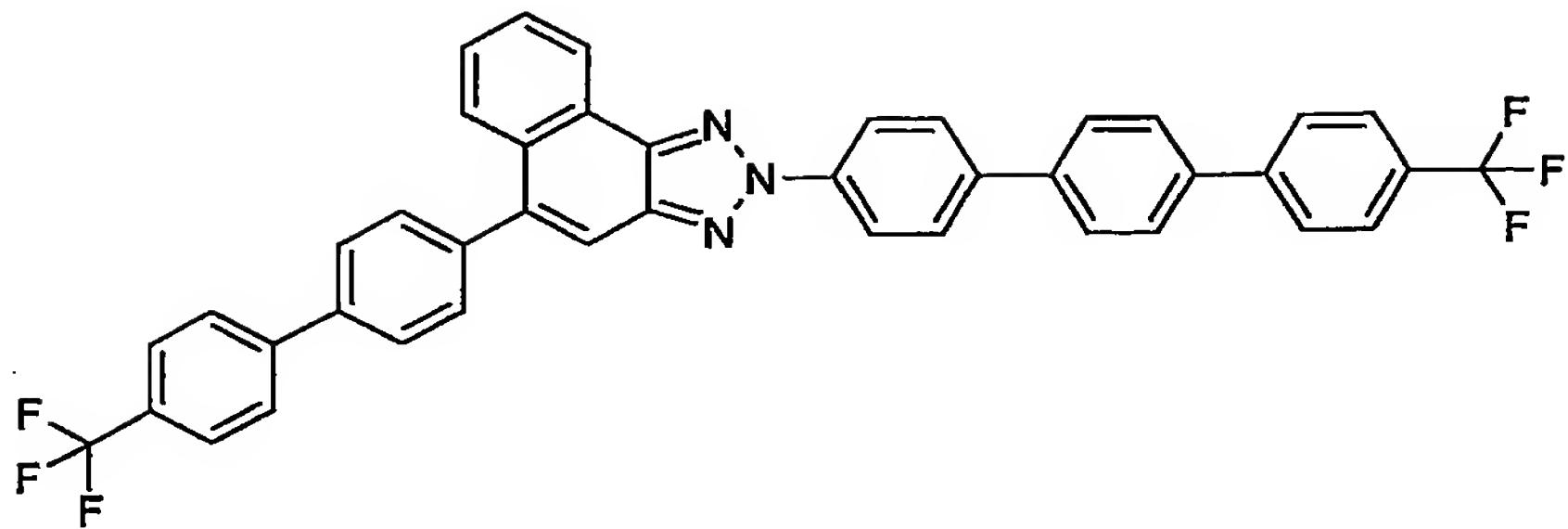
A^{23} is as defined above, R^{25} is C_1 - C_{12} alkyl, X^{68} and X^{69} are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, and

5 A^{12} is $NR^{25}R^{26}$, , , or 

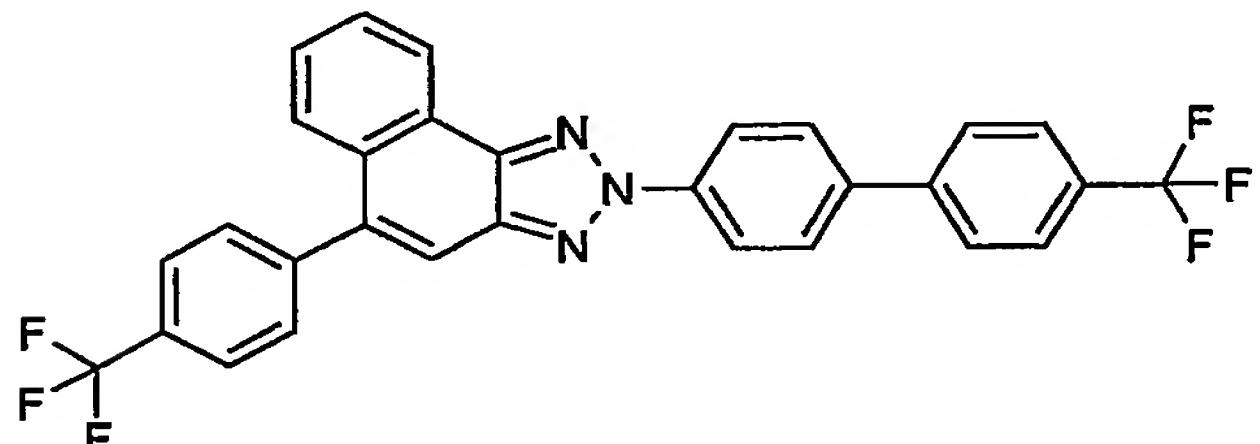
R^{25} and R^{26} are C_6 - C_{14} aryl, especially phenyl, 1-naphthyl, 2-naphthyl, which can optionally be substituted by one, or two C_1 - C_8 alkyl groups, or C_1 - C_8 alkoxy groups.

Examples of especially preferred 2H-benzotriazole compounds are shown below:

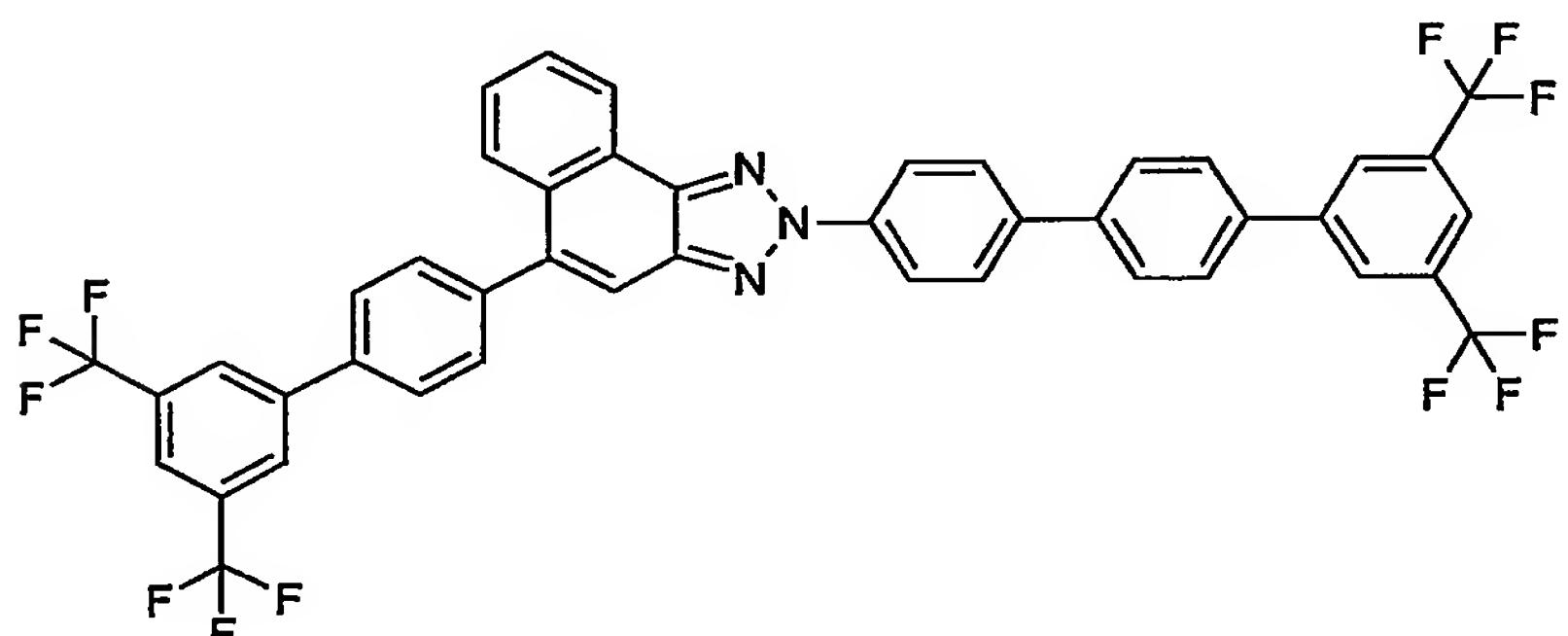




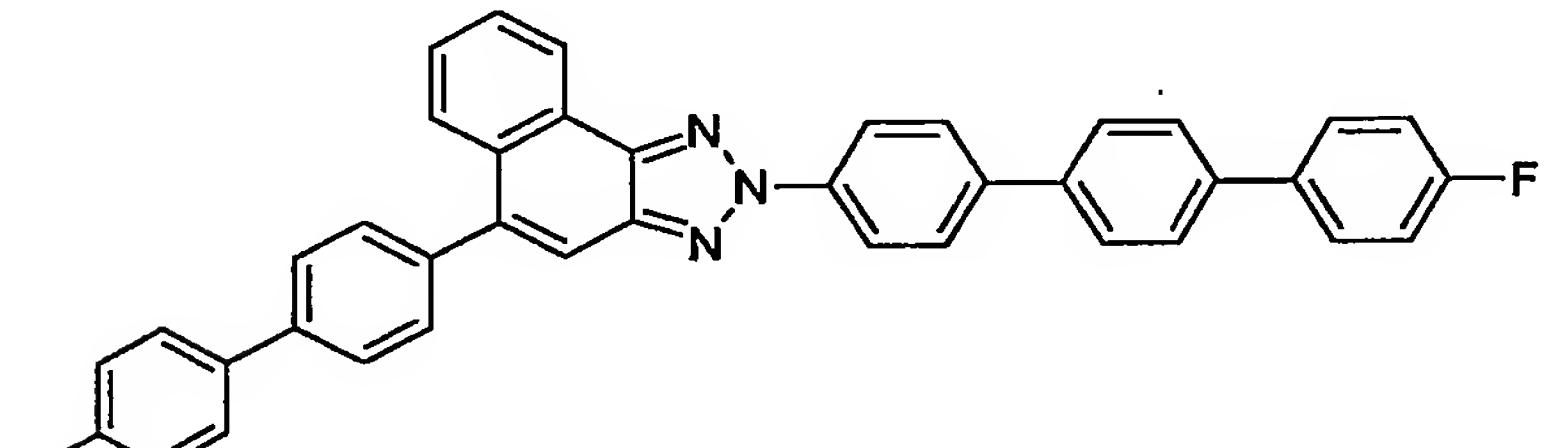
(A-3),



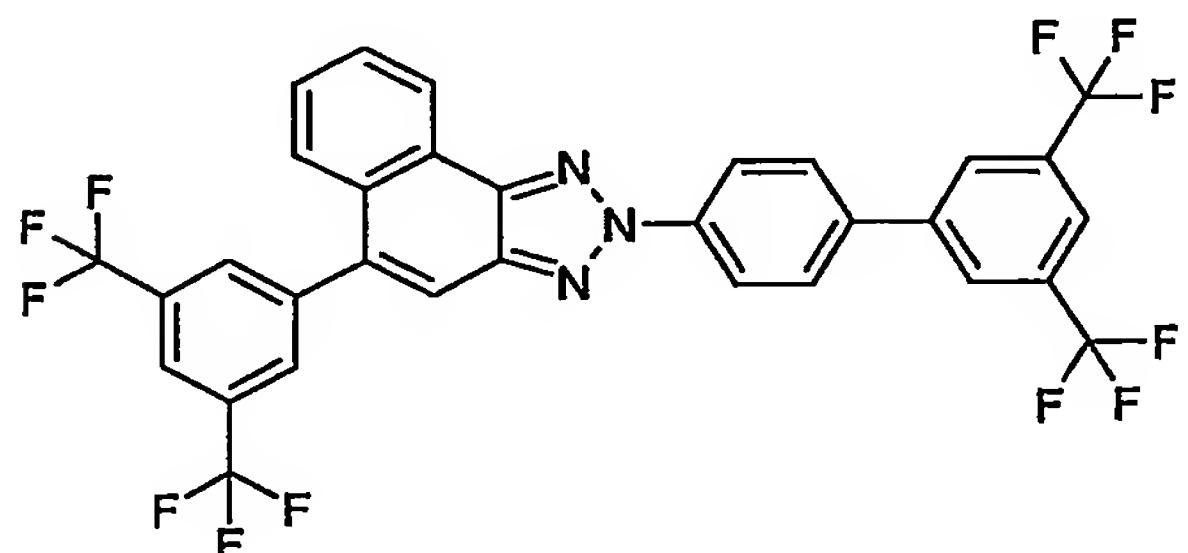
(A-4),



(A-5),

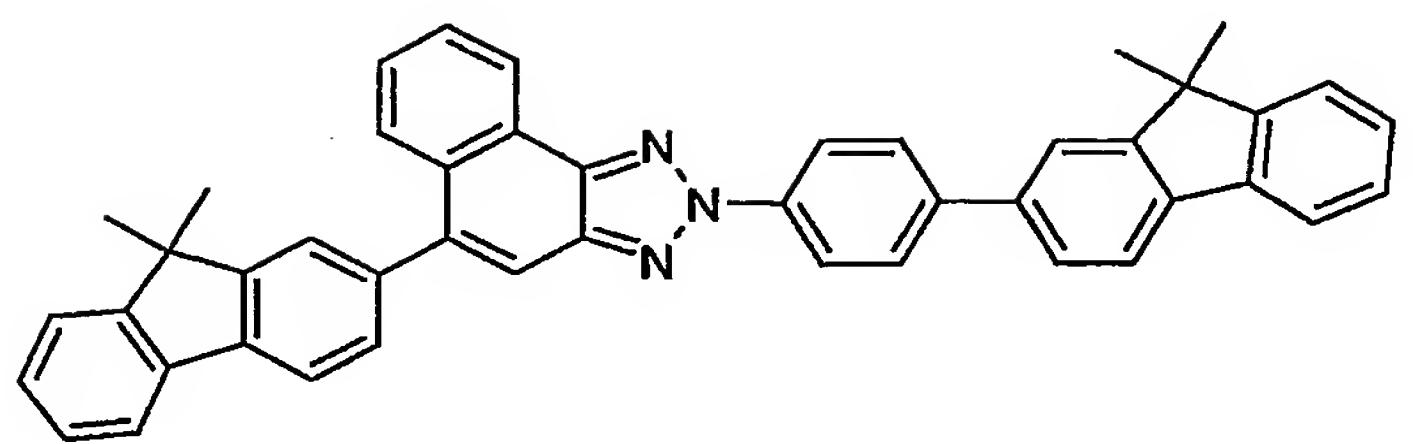


(A-6),

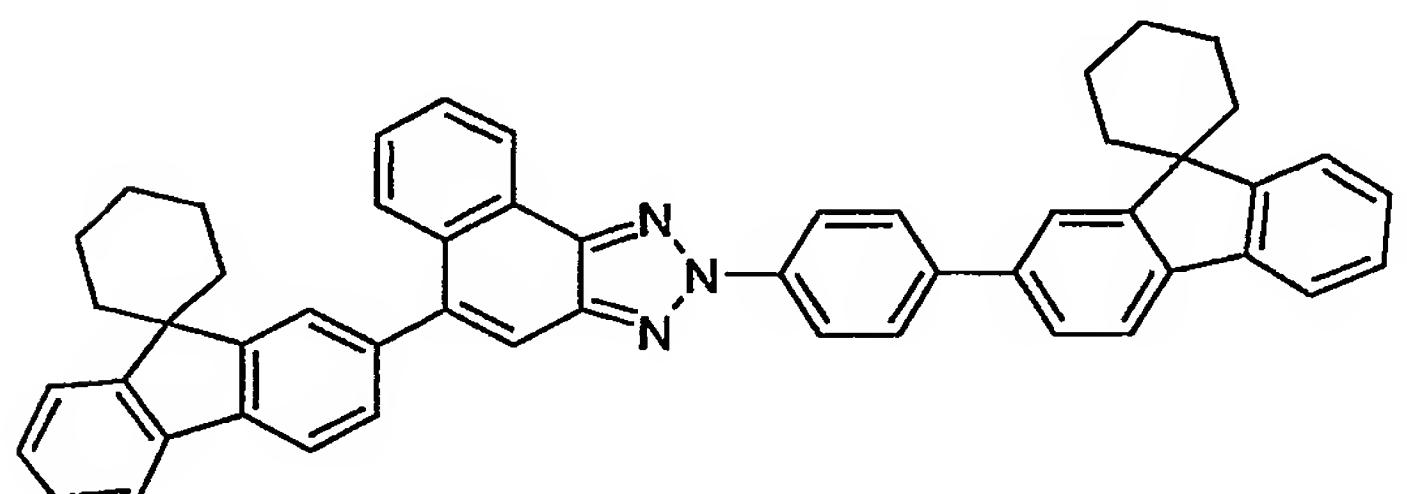


(A-7),

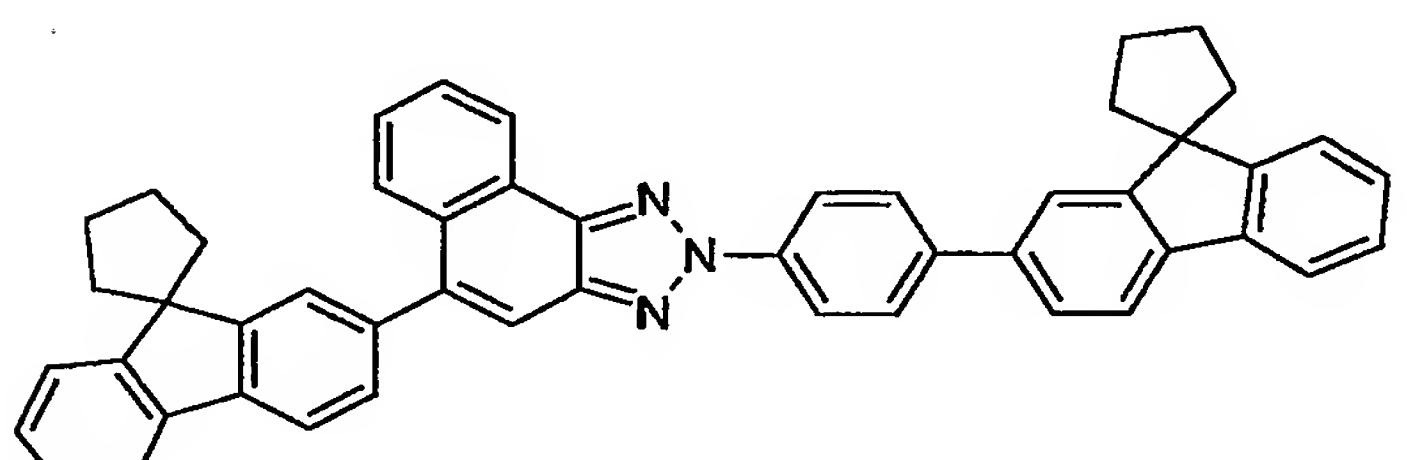
23



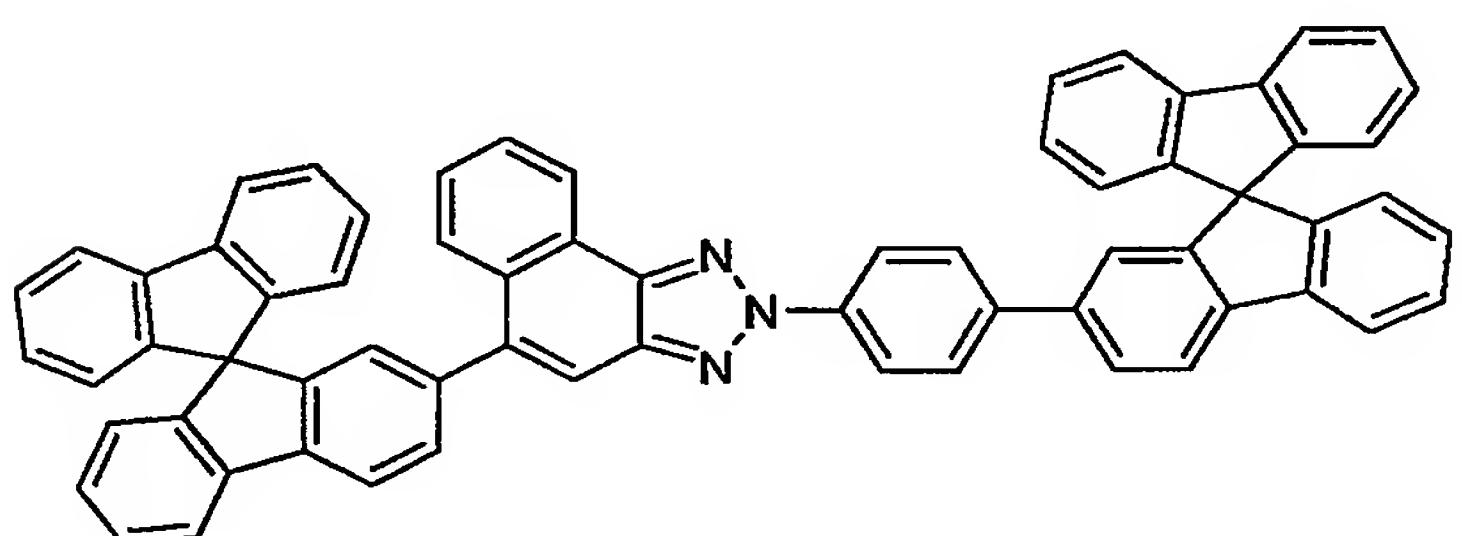
(A-8),



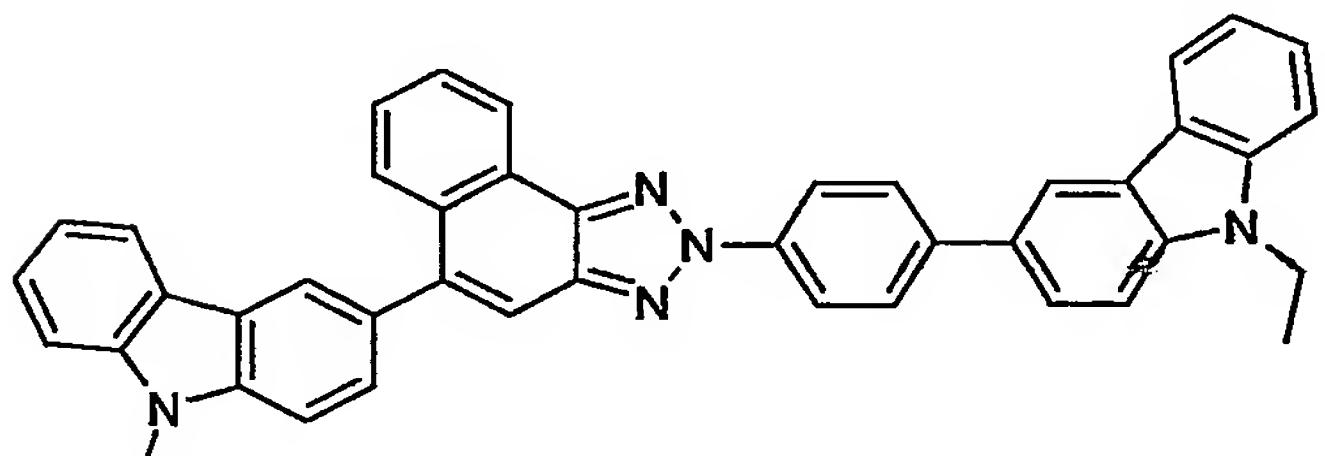
(A-9),



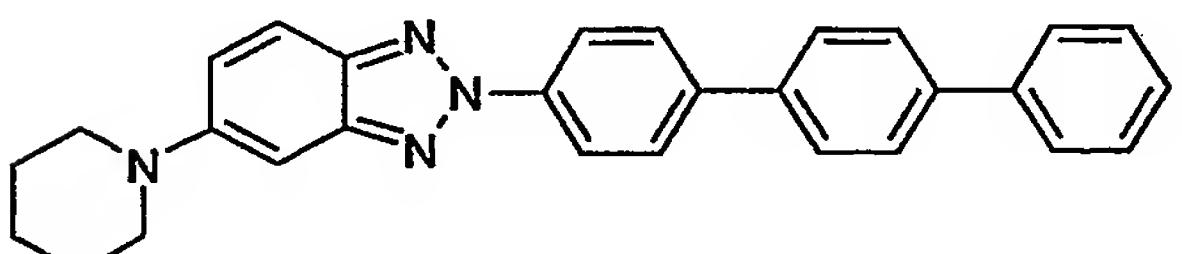
(A-10),



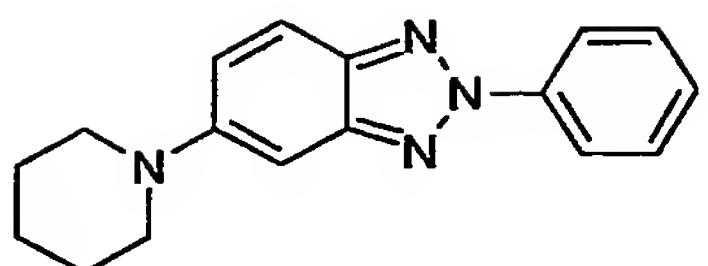
(A-11),



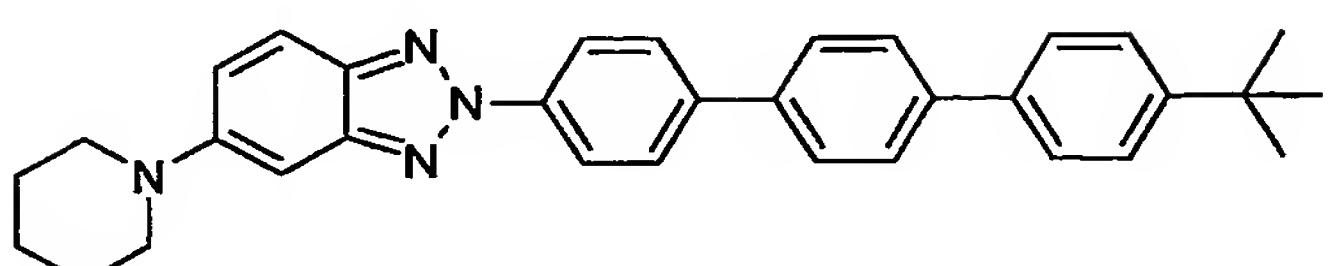
(A-12),



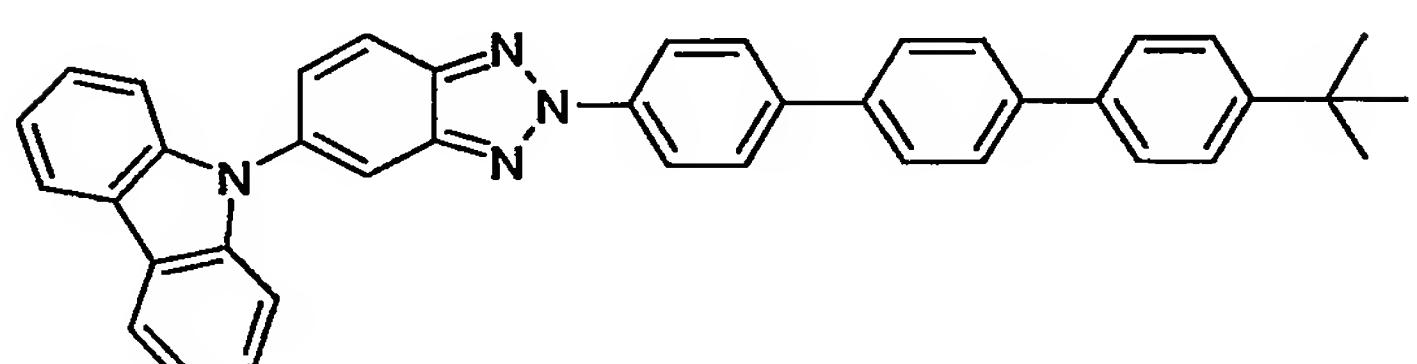
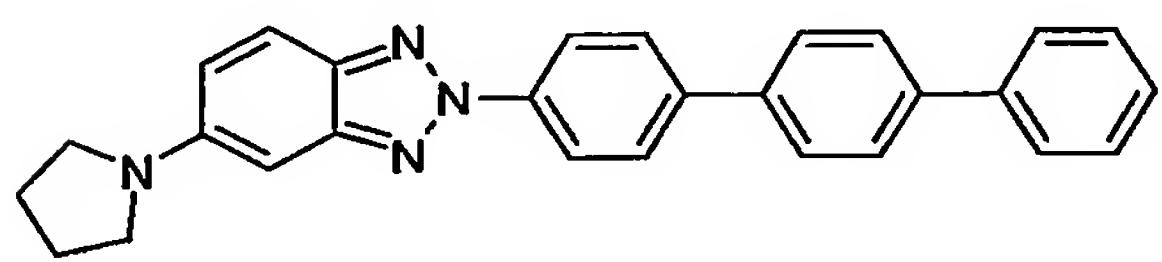
(B-1),



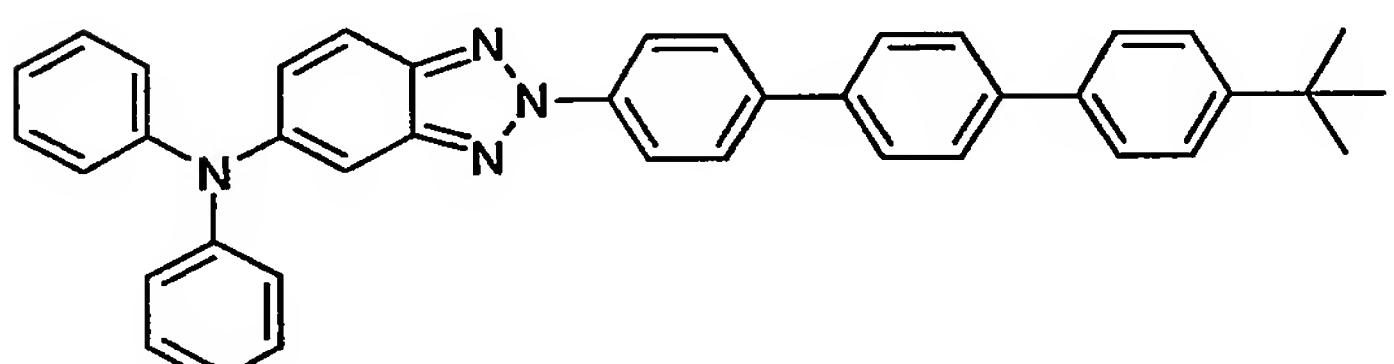
(B-2),



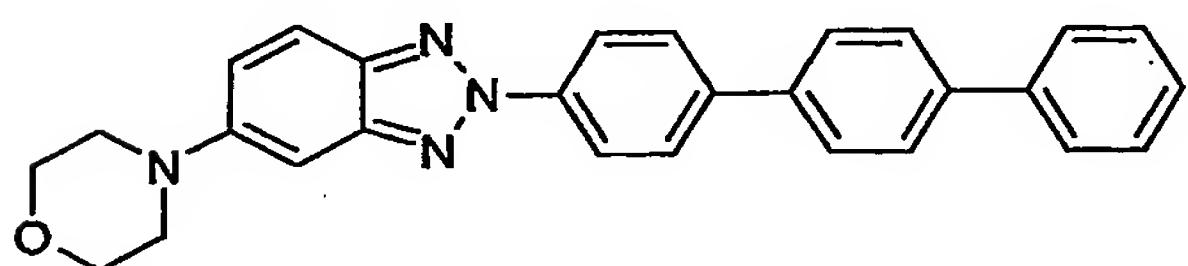
(B-3),



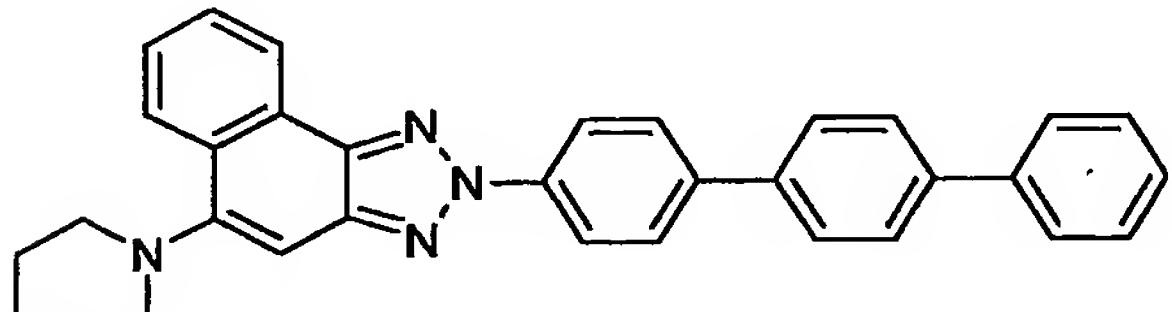
(B-4),



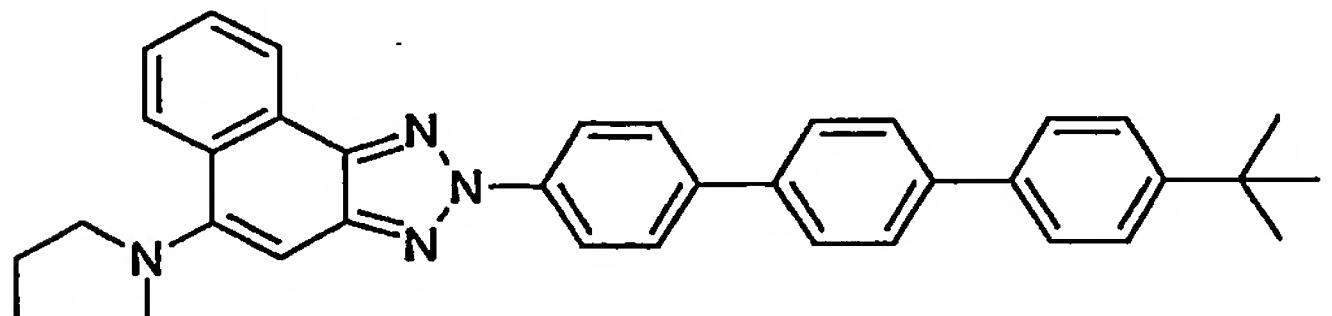
(B-5),



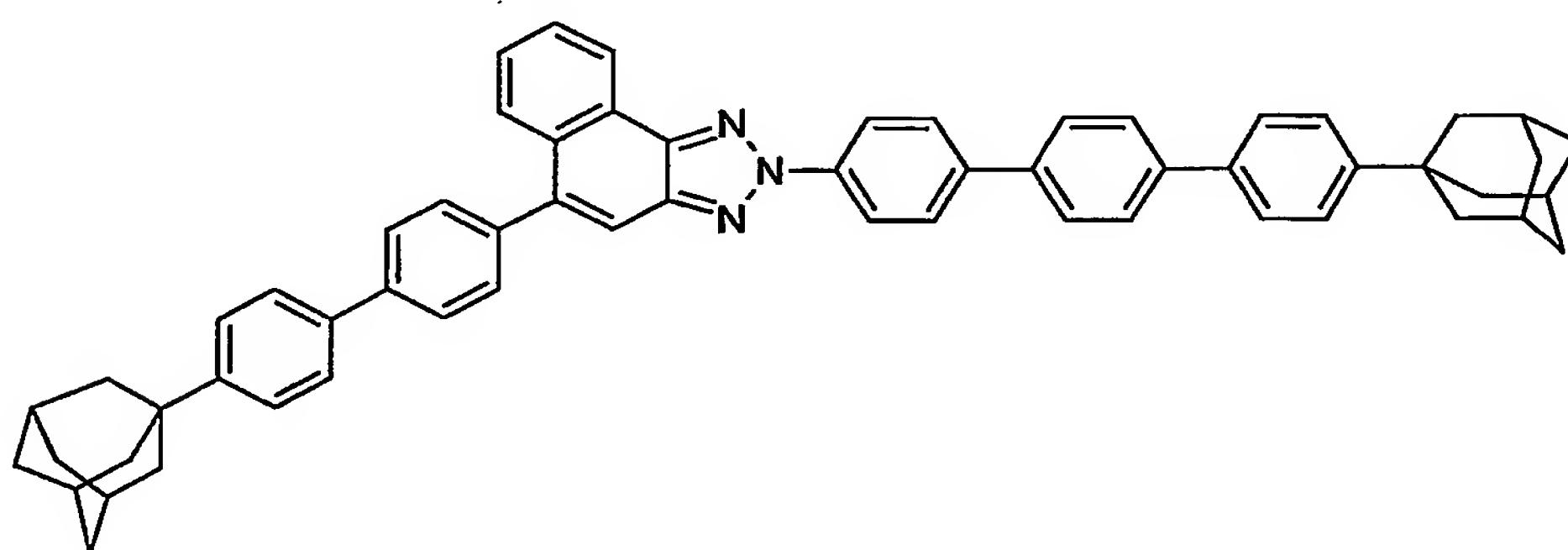
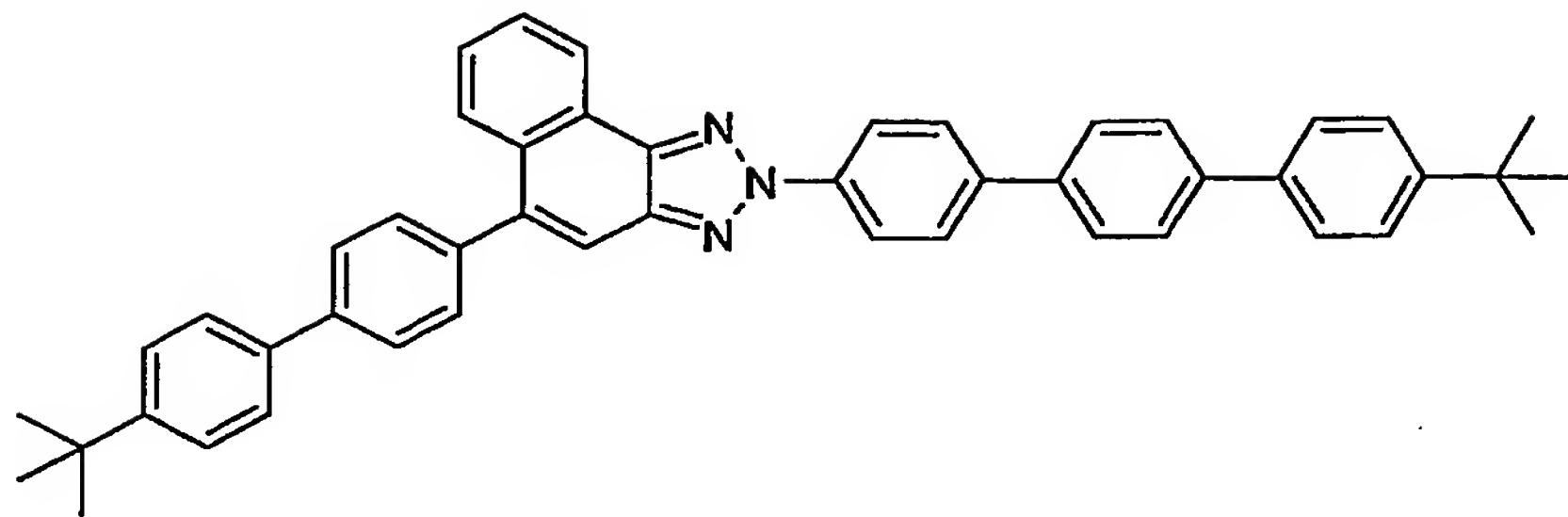
(B-6),



(B-7),



(B-8),



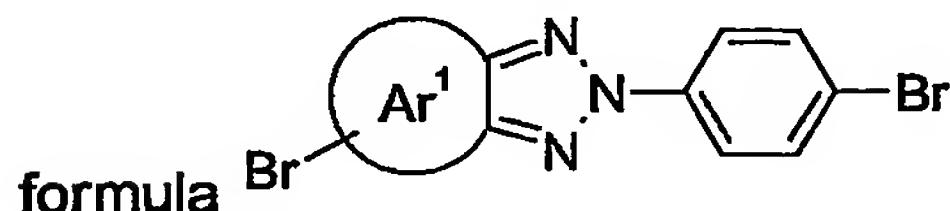
The 2H-benzotriazole compounds of formula IIIa, IIIb and IIIc, especially compounds A-1 to
 5 A-12, are preferably used as host compounds, whereas the 2H-benzotriazole compounds of
 formula IVa, IVb and IVc, especially compounds B-1 to B-10, are preferably used as guest
 compounds in the light emitting layer of EL devices.

If the 2H-benzotriazole compounds of formula IIIa, IIIb and IIIc (= III) are used as host and
 10 the 2H-benzotriazole compounds of formula IVa, IVb and IVc (=IV) are used as guest, the weight ratio of the the 2H-benzotriazole compound of the formula III to the 2H-benzotriazole compound of the formula IV is in general 50:50 to 99.99:0.01, preferably 90:10 to 99.99:0.01, more preferably 95:5 to 99.9:0.1.

15 The inventive 2H-benzotriazole compounds can be synthesized according to or in analogy to methods well known in the art.

The 2H-benzotriazoles of may be prepared by any suitable process, for example, by the condensation reaction of an aromatic boronate and a bromide, commonly referred to as the
 20 "Suzuki reaction", which is tolerant of the presence of a variety of organic functional groups as reported by N. Miyaura and A. Suzuki in Chemical Reviews, Vol. 95, pp. 457-2483 (1995).

To prepare 2H-benzotriazoles corresponding to formula (I) 2 equivalents of a bromide of



are reacted with two equivalents boronate corresponding to formula $\text{X}^{11}-\text{A}^{23}$ or a mixture thereof, wherein X^{11} is independently in each occurrence a

$-\text{B}(\text{OH})_2$, $-\text{B}(\text{OY}^{11})_2$ or

, wherein Y^{11} is independently in each occurrence a $\text{C}_1\text{-C}_{10}$ alkyl group and Y^{12} is independently in each occurrence a $\text{C}_2\text{-C}_{10}$ alkylene group, such as $-\text{CY}^{13}\text{Y}^{14}-\text{CY}^5\text{Y}^6-$, or $-\text{CY}^7\text{Y}^8-\text{CY}^9\text{Y}^{10}-\text{CY}^{15}\text{Y}^{16}-$, wherein Y^5 , Y^6 , Y^7 , Y^8 , Y^9 , Y^{10} , Y^{13} , Y^{14} , Y^{15} and Y^{16} are independently of each other hydrogen, or a $\text{C}_1\text{-C}_{10}$ alkyl group, especially $-\text{C}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2-$, or $-\text{C}(\text{CH}_3)_2\text{CH}_2\text{C}(\text{CH}_3)_2-$, under the catalytic action of Pd and triphenylphosphine. The reaction is typically conducted at about 70 °C to 120 °C in an aromatic hydrocarbon solvent such as toluene. Other solvents such as dimethylformamide and tetrahydrofuran can also be used alone, or in mixtures with an aromatic hydrocarbon. An aqueous base, preferably sodium carbonate or bicarbonate, is used as the HBr scavenger. Depending on the reactivities of the reactants, a reaction may take 2 to 100 hours. Organic bases, such as, for example, tetraalkylammonium hydroxide, and phase transfer catalysts, such as, for example TBAB, can promote the activity of the boron (see, for example, Leadbeater & Marco; Angew. Chem. Int. Ed., 2003, 42, 1407 and references cited therein).

Halogen is fluorine, chlorine, bromine and iodine.

$\text{C}_1\text{-C}_{24}$ alkyl is a branched or unbranched radical such as for example methyl, ethyl, propyl, isopropyl, n-butyl, sec-butyl, isobutyl, tert-butyl, 2-ethylbutyl, n-pentyl, isopentyl, 1-methylpentyl, 1,3-dimethylbutyl, n-hexyl, 1-methylhexyl, n-heptyl, isoheptyl, 1,1,3,3-tetramethylbutyl, 1-methylheptyl, 3-methylheptyl, n-octyl, 2-ethylhexyl, 1,1,3-trimethylhexyl, 1,1,3,3-tetramethylpentyl, nonyl, decyl, undecyl, 1-methylundecyl, dodecyl, 1,1,3,3,5,5-hexamethylhexyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, icosyl or docosyl.

$\text{C}_1\text{-C}_{24}$ perfluoroalkyl is a branched or unbranched radical such as for example $-\text{CF}_3$, $-\text{CF}_2\text{CF}_3$, $-\text{CF}_2\text{CF}_2\text{CF}_3$, $-\text{CF}(\text{CF}_3)_2$, $-(\text{CF}_2)_3\text{CF}_3$, and $-\text{C}(\text{CF}_3)_3$.

$\text{C}_1\text{-C}_{24}$ alkoxy radicals are straight-chain or branched alkoxy radicals, e.g. methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, sec-butoxy, tert-butoxy, amyloxy, isoamyloxy or tert-amyoxy,

heptyloxy, octyloxy, isoctyloxy, nonyloxy, decyloxy, undecyloxy, dodecyloxy, tetradecyloxy, pentadecyloxy, hexadecyloxy, heptadecyloxy and octadecyloxy.

C₂-C₂₄alkenyl radicals are straight-chain or branched alkenyl radicals, such as e.g. vinyl, allyl, 5 methallyl, isopropenyl, 2-butenyl, 3-butenyl, isobut enyl, n-penta-2,4-dienyl, 3-methyl-but-2-enyl, n-oct-2-enyl, n-dodec-2-enyl, isododecenyl, n-dodec-2-enyl or n-octadec-4-enyl.

C₂₋₂₄alkynyl is straight-chain or branched and preferably C₂₋₈alkynyl, which may be unsubstituted or substituted, such as, for example, ethynyl, 1-propyn-3-yl, 1-butyn-4-yl, 10 1-pentyn-5-yl, 2-methyl-3-butyn-2-yl, 1,4-pentadiyn-3-yl, 1,3-pentadiyn-5-yl, 1-hexyn-6-yl, cis-3-methyl-2-penten-4-yn-1-yl, trans-3-methyl-2-penten-4-yn-1-yl, 1,3-hexadiyn-5-yl, 1-octyn-8-yl, 1-nonyn-9-yl, 1-decyn-10-yl, or 1-tetracosyn-24-yl.

C₄-C₁₈cycloalkyl, especially C₅-C₁₂cycloalkyl, is preferably C₅-C₁₂cycloalkyl or said cycloalkyl 15 substituted by one to three C₁-C₄alkyl groups, such as, for example, cyclopentyl, methylcyclopentyl, dimethylcyclopentyl, cyclohexyl, methylcyclohexyl, dimethylcyclohexyl, trimethylcyclohexyl, tert-butylcyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cyclododecyl, 1-adamantyl, or 2-adamantyl. Cyclohexyl, 1-adamantyl and cyclopentyl are most preferred.

20 Examples of C₄-C₁₈cycloalkyl, which is interrupted by S, O, or NR²⁵, are piperidyl, piperazinyl and morpholinyl.

C₂-C₂₄alkenyl is for example vinyl, allyl, butenyl, pentenyl, hexenyl, heptenyl, or octenyl.

25 **Aryl** is usually C₆-C₃₀aryl, preferably C₆-C₂₄aryl, which optionally can be substituted, such as, for example, phenyl, 4-methylphenyl, 4-methoxyphenyl, naphthyl, biphenylyl, 2-fluorenyl, phenanthryl, anthryl, tetracyl, pentacyl, hexacyl, terphenylyl or quadphenylyl; or phenyl substituted by one to three C₁-C₄alkyl groups, for example o-, m- or p-methylphenyl, 2,3-dimethylphenyl, 2,4-dimethylphenyl, 2,5-dimethylphenyl, 2,6-dimethylphenyl, 3,4-dimethylphenyl, 3,5-dimethylphenyl, 2-methyl-6-ethylphenyl, 4-tert-butylphenyl, 2-ethylphenyl or 2,6-diethylphenyl.

C₇-C₂₄aralkyl radicals are preferably C₇-C₁₅aralkyl radicals, which may be substituted, such as, for example, benzyl, 2-benzyl-2-propyl, β-phenethyl, α-methylbenzyl, α,α-dimethylbenzyl, 35 ω-phenyl-butyl, ω-phenyl-octyl, ω-phenyl-dodecyl; or phenyl-C₁-C₄alkyl substituted on the phenyl ring by one to three C₁-C₄alkyl groups, such as, for example, 2-methylbenzyl, 3-

methylbenzyl, 4-methylbenzyl, 2,4-dimethylbenzyl, 2,6-dimethylbenzyl or 4-tert-butylbenzyl or 3-methyl-5-(1',1',3',3'-tetramethyl-butyl)-benzyl.

Heteroaryl is typically C₂-C₂₆heteroaryl, i.e. a ring with five to seven ring atoms or a

5 condensed rig system, wherein nitrogen, oxygen or sulfur are the possible hetero atoms, and is typically an unsaturated heterocyclic radical with five to 30 atoms having at least six conjugated π -electrons such as thienyl, benzo[b]thienyl, dibenzo[b,d]thienyl, thianthrenyl, furyl, furfuryl, 2H-pyranyl, benzofuranyl, isobenzofuranyl, dibenzofuranyl, phenoxythienyl, pyrrolyl, imidazolyl, pyrazolyl, pyridyl, bipyridyl, triazinyl, pyrimidinyl, pyrazinyl, pyridazinyl, 10 indolizinyl, isoindolyl, indolyl, indazolyl, purinyl, quinolizinyl, chinolyl, isochinolyl, phthalazinyl, naphthyridinyl, chinoxaliny, chinazolinyl, cinnolinyl, pteridinyl, carbazolyl, carbolinyl, benzotriazolyl, benzoxazolyl, phenanthridinyl, acridinyl, perimidinyl, phenanthrolinyl, phenazinyl, isothiazolyl, phenothiazinyl, isoxazolyl, furazanyl or phenoxazinyl, which can be unsubstituted or substituted.

15 C₆-C₁₈cycloalkoxy is, for example, cyclopentyloxy, cyclohexyloxy, cycloheptyloxy or cyclooctyloxy, or said cycloalkoxy substituted by one to three C₁-C₄alkyl, for example, methylcyclopentyloxy, dimethylcyclopentyloxy, methylcyclohexyloxy, dimethylcyclohexyloxy, trimethylcyclohexyloxy, or tert-butylcyclohexyloxy.

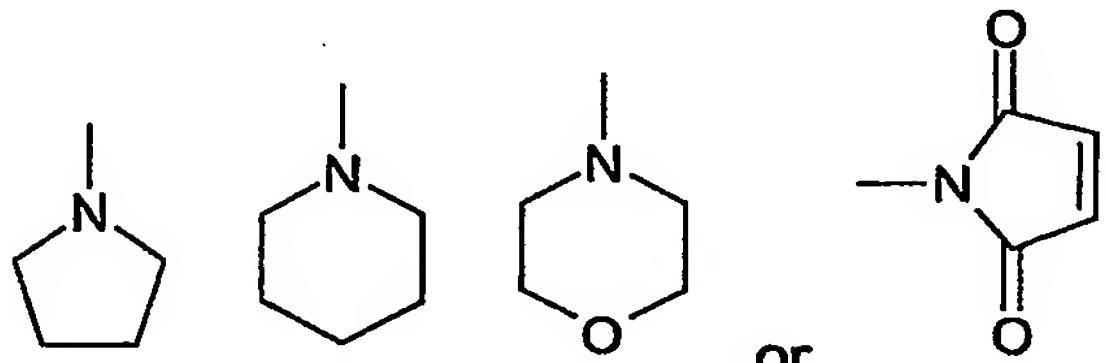
20 C₆-C₂₄aryloxy is typically phenoxy or phenoxy substituted by one to three C₁-C₄alkyl groups, such as, for example o-, m- or p-methylphenoxy, 2,3-dimethylphenoxy, 2,4-dimethylphenoxy, 2,5-dimethylphenoxy, 2,6-dimethylphenoxy, 3,4-dimethylphenoxy, 3,5-dimethylphenoxy, 2-methyl-6-ethylphenoxy, 4-tert-butylphenoxy, 2-ethylphenoxy or 2,6-diethylphenoxy.

25 C₆-C₂₄aralkoxy is typically phenyl-C₁-C₉alkoxy, such as, for example, benzyloxy, α -methylbenzyloxy, α,α -dimethylbenzyloxy or 2-phenylethoxy.

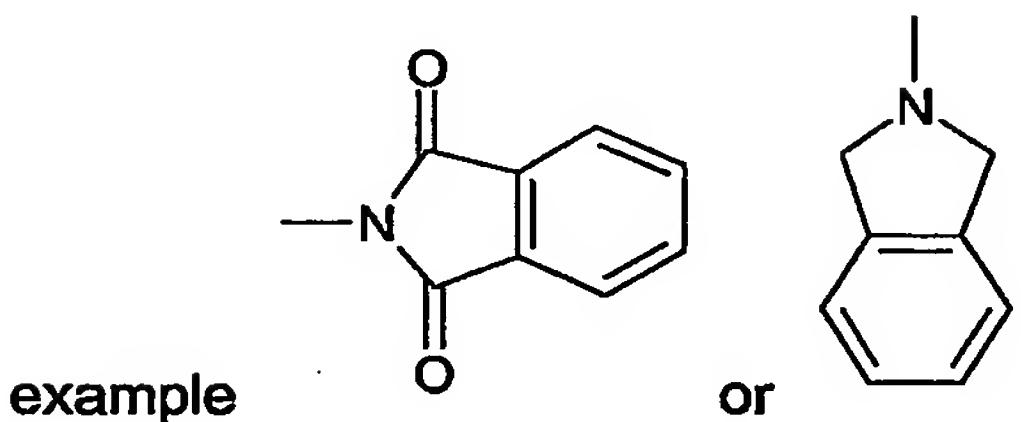
C₁-C₂₄alkylthio radicals are straight-chain or branched alkylthio radicals, such as e.g. 30 methylthio, ethylthio, propylthio, isopropylthio, n-butylthio, isobutylthio, pentylthio, isopentylthio, hexylthio, heptylthio, octylthio, decylthio, tetradecylthio, hexadecylthio or octadecylthio. C₁-C₂₄alkylselenium and C₁-C₂₄alkyltellurium are C₁-C₂₄alkylSe- and C₁-C₂₄alkylTe-, respectively.

35 Examples of a five or six membered ring formed by R⁹ and R¹⁰ and R²⁵ and R²⁶, respectively are heterocycloalkanes or heterocycloalkenes having from 3 to 5 carbon atoms which can

have one additional hetero atom selected from nitrogen, oxygen and sulfur, for example



, or , which can be part of a bicyclic system, for



example .

- 5 Possible substituents of the above-mentioned groups are C₁-C₈alkyl, a hydroxyl group, a mercapto group, C₁-C₈alkoxy, C₁-C₈alkylthio, halogen, halo-C₁-C₈alkyl, a cyano group, an aldehyde group, a ketone group, a carboxyl group, an ester group, a carbamoyl group, an amino group, a nitro group or a silyl group.
- 10 The term "haloalkyl" means groups given by partially or wholly substituting the above-mentioned alkyl group with halogen, such as trifluoromethyl etc. The "aldehyde group, ketone group, ester group, carbamoyl group and amino group" include those substituted by an C₁-C₂₄alkyl group, a C₄-C₁₈cycloalkyl group, an C₆-C₃₀aryl group, an C₇-C₂₄aralkyl group or a heterocyclic group, wherein the alkyl group, the cycloalkyl group, the aryl group, the aralkyl group and the heterocyclic group may be unsubstituted or substituted. The term "silyl group" means a group of formula $-\text{SiR}^{105}\text{R}^{106}\text{R}^{107}$, wherein R¹⁰⁵, R¹⁰⁶ and R¹⁰⁷ are independently of each other a C₁-C₈alkyl group, in particular a C₁-C₄ alkyl group, a C₆-C₂₄aryl group or a C₇-C₁₂aralkylgroup, such as a trimethylsilyl group.
- 15 20 If a substituent, such as, for example R⁶ and R⁷, occurs more than one time in a group, it can be different in each occurrence.

As described above, the aforementioned radicals may be substituted by E and/or, if desired, interrupted by D. Interruptions are of course possible only in the case of radicals containing at least 2 carbon atoms connected to one another by single bonds; C₆-C₁₈aryl is not interrupted; interrupted arylalkyl or alkylaryl contains the unit D in the alkyl moiety. C₁-C₂₄alkyl substituted by one or more E and/or interrupted by one or more units D is, for example, (CH₂CH₂O)_n-R^x, where n is a number from the range 1-9 and R^x is H or C₁-C₁₀alkyl or C₂-C₁₀alkanoyl (e.g. CO-CH(C₂H₅)C₄H₉), CH₂-CH(OR^y)-CH₂-O-R^y, where R^y is C₁-C₂₄alkyl,

C_5-C_{12} cycloalkyl, phenyl, C_7-C_{15} phenylalkyl, and R^y embraces the same definitions as R^y or is H; C_1-C_8 alkylene-COO-R^z, e.g. CH_2COOR^z , $CH(CH_3)COOR^z$, $C(CH_3)_2COOR^z$, where R^z is H, C_1-C_{24} alkyl, $(CH_2CH_2O)_{1-9}R^x$, and R^x embraces the definitions indicated above; $CH_2CH_2-O-CO-CH=CH_2$; $CH_2CH(OH)CH_2-O-CO-C(CH_3)=CH_2$.

5 The blue-emitting 2H-benzotriazoles of this invention emit light below about 520 nm, for example between about 380 nm and about 520 nm. For example, the blue-emitting 2H-benzotriazoles of this invention have a NTSC coordinate of about (0.14, 0.08), where the first coordinate is between about 0.12 and about 0.16, and the second coordinate is between
10 about 0.05 and about 0.10.

The present compounds of formula I, II, III, or IV may also function as other than a blue-emitting organic compound, for example they may also function as a hole-injecting, hole-transporting, and electron-injecting or an electron-transporting material.

15 The organic EL device of the present invention has significant industrial values since it can be adapted for a flat panel display of an on-wall television set, a flat light-emitting device, a light source for a copying machine or a printer, a light source for a liquid crystal display or counter, a display signboard and a signal light.

20 The material of the present invention can be used in the fields of an organic EL device, an electrophotographic photoreceptor, a photoelectric converter, a solar cell, and an image sensor.

25 To obtain organic layers of this invention with the proper T_g , or glass transition temperature, it is advantageous that the present 2H-benzotriazoles have a melting point greater than about 150°C, for example greater than about 200°C, for example greater than about 250°C, for instance greater than about 300°C.

30 The electroluminescent devices of the present invention are otherwise designed as is known in the art, for example as described in U.S. Pat. Nos. 5,518,824, 6,280,859, 5,629,389, 5,486,406, 5,104,740 and 5,116,708, the relevant disclosures of which are hereby incorporated by reference.

35 The present invention relates to an electroluminescent device having the 2H-benzotriazoles of formula I between an anode and a cathode and emitting light by the action of electrical energy.

Typical constitutions of latest organic electroluminescent devices are:

(i) an anode/a hole transporting layer/an electron transporting layer/a cathode, in which 2H-benzotriazoles of formula I are used either as positive-hole transport compound, which is
5 exploited to form the light emitting and hole transporting layers, or as electron transport compound, which can be exploited to form the light-emitting and electron transporting layers,
(ii) an anode/a hole transporting layer/a light-emitting layer/an electron transporting layer/a cathode, in which the 2H-benzotriazoles of formula I form the light-emitting layer regardless of whether they exhibit positive-hole or electron transport properties in this
10 constitution,
(iii) an anode/a hole injection layer /a hole transporting layer/a light-emitting layer/an electron transporting layer/a cathode,
(iv) an anode/a hole transporting layer/a light-emitting layer/ a positive hole inhibiting layer/ an electron transporting layer/a cathode,
15 (v) an anode/a hole injection layer/a hole transporting layer/a light-emitting layer/ a positive hole inhibiting layer/an electron transporting layer/a cathode,
(vi) an anode/a light-emitting layer/an electron transporting layer/a cathode,
(vii) an anode/a light-emitting layer/a positive hole inhibiting layer/an electron transporting layer/a cathode,
20 (viii) a mono-layer containing a light emitting material alone or a combination of a light emitting material and any of the materials of the hole transporting layer, the hole-blocking layer and/or the electron transporting layer, and
(ix) a multi-layered structure described in (ii) to (vii), wherein a light emitting layer is the mono-layer defined in (viii).

25

The 2H-benzotriazoles of formula I can, in principal be used for any organic layer, such as, for example, hole transporting layer, light emitting layer, or electron transporting layer, but are preferably used as the light emitting material in the light emitting layer, optionally as a host or guest component.

30

The light emitting compounds of this invention exhibit intense fluorescence in the solid state and have excellent electric-field-applied light emission characteristics. Further, the light emitting compounds of this invention are excellent in the injection of holes from a metal electrode and the transportation of holes; as well as being excellent in the injection of electrons from a metal electrode and the transportation of electrons. They are effectively
35

used as light emitting materials and may be used in combination with other hole transporting materials, other electron transporting materials or other dopants.

The 2H-benzotriazoles of the present invention form uniform thin films. The light emitting layers may therefore be formed of the present 2H-benzotriazoles alone.

5 Alternatively, the light-emitting layer may contain a known light-emitting material, a known dopant, a known hole-injecting material or a known electron-injecting material as required. In the organic EL device, a decrease in the brightness and life caused by quenching can be prevented by forming it as a multi-layered structure. The light-emitting material, a dopant, a hole-injecting material and an electron-injecting material may be used in combination as required. Further, a dopant can improve the light emission brightness and the light emission efficiency, and can attain red, green or blue light emission. Further, each of the hole-injecting zone, the light-emitting layer and the electron-injecting zone may have the layer structure of at least two layers. In the hole-injecting zone in this case, a layer to which holes are injected from an electrode is called "hole-injecting layer", and a layer which receives holes from the 10 hole-injecting layer and transport the holes to a light-emitting layer is called "hole-transporting layer". In the electron-injecting zone, a layer to which electrons are injected from an electrode is called "electron-injecting layer", and a layer which receives electrons from the electron-injecting layer and transports the electrons to a light-emitting layer is called "electron- 15 transporting layer". These layers are selected and used depending upon factors such as the energy level and heat resistance of materials and adhesion to an organic layer or metal electrode.

20

The light-emitting material or the dopant which may be used in the light-emitting layer together with the 2H-benzotriazoles of the present invention includes for example 25 anthracene, naphthalene, phenanthrene, pyrene, tetracene, coronene, chrysene, fluorescein, perylene, phthaloperylene, naphthaloperylene, perinone, phthaoperinone, naphthaloperinone, diphenylbutadiene, tetraphenylbutadiene, coumarine, oxadiazole, aldazine, bisbenzoxazoline, bisstyryl, pyrazine, cyclopentadiene, quinoline metal complex, aminoquinoline metal complex, benzoquinoline metal complex, imine, diphenylethylene, vinyl 30 anthracene, diaminocarbazole, pyran, thiopyran, polymethine, merocyanine, an imidazole-chelated oxynoid compound, quinacridone, rubrene, and fluorescent dyestuffs for a dyestuff laser or for brightening.

The 2H-benzotriazoles of the present invention and the above compound or compounds that 35 can be used in a light-emitting layer may be used in any mixing ratio for forming a light-emitting layer. That is, 2H-benzotriazoles of the present invention may provide a main

component for forming a light-emitting layer, or they may be a doping material in another main material, depending upon a combination of the above compounds with the present 2H-benzotriazoles of the present invention. Good results are, for example, achieved, when DPVBi (4,4'-bis-(2,2-diphenyl-1-vinyl) biphenyl) is used as host and compounds A-1 to A-12
5 are used as guest.

Thin film type electroluminescent devices usually consist essentially of a pair of electrodes and at least one charge transporting layer in between. Usually two charge transporting layers, a hole transporting layer (next to the anode) and an electron transporting layer (next
10 to the cathode) are present. Either one of them contains - depending on its properties as hole-transporting or electron-transporting material - an inorganic or organic fluorescence substance as light-emitting material. It is also common, that a light-emitting material is used as an additional layer between the hole-transporting and the electron-transporting layer. In the above mentioned device structure, a hole injection layer can be constructed between an
15 anode and a hole transporting layer and/or a positive hole inhibiting layer can be constructed between a light emitting layer and an electron transporting layer to maximise hole and electron population in the light emitting layer, reaching large efficiency in charge recombination and intensive light emission.

The devices can be prepared in several ways. Usually, vacuum evaporation is used for the
20 preparation. Preferably, the organic layers are laminated in the above order on a commercially available indium-tin-oxide ("ITO") glass substrate held at room temperature, which works as the anode in the above constitutions. The membrane thickness is preferably in the range of 1 to 10,000 nm, more preferably 1 to 5,000 nm, more preferably 1 to 1,000 nm, more preferably 1 to 500 nm. The cathode metal, such as a Mg/Ag alloy, a binary Li-Al
25 or LiF-Al system with an thickness in the range of 50-200 nm is laminated on the top of the organic layers. The vacuum during the deposition is preferably less than 0.1333 Pa ($1 \times 10^{-3} \text{ Torr}$), more preferably less than $1.333 \times 10^{-3} \text{ Pa}$ ($1 \times 10^{-5} \text{ Torr}$), more preferably less than $1.333 \times 10^{-4} \text{ Pa}$ ($1 \times 10^{-6} \text{ Torr}$).

As anode usual anode materials which possess high work function such as metals like gold,
30 silver, copper, aluminum, indium, iron, zinc, tin, chromium, titanium, vanadium, cobalt, nickel, lead, manganese, tungsten and the like, metallic alloys such as magnesium/copper, magnesium/silver, magnesium/aluminum, aluminum/indium and the like, semiconductors such as Si, Ge, GaAs and the like, metallic oxides such as indium-tin-oxide ("ITO"), ZnO and the like, metallic compounds such as Cul and the like, and furthermore, electroconducting
35 polymers, such as polyacetylene, polyaniline, polythiophene, polypyrrole, polyparaphenylene and the like, preferably ITO, most preferably ITO on glass as substrate can be used.

Of these electrode materials, metals, metallic alloys, metallic oxides and metallic compounds can be transformed into electrodes, for example, by means of the sputtering method. In the case of using a metal or a metallic alloy as a material for an electrode, the electrode can be formed also by the vacuum deposition method. In the case of using a metal or a metallic 5 alloy as a material forming an electrode, the electrode can be formed, furthermore, by the chemical plating method (see for example, Handbook of Electrochemistry, pp 383-387, Mazuren, 1985). In the case of using an electroconducting polymer, an electrode can be made by forming it into a film by means of anodic oxidation polymerization method onto a substrate which is previously provided with an electroconducting coating. The thickness of an 10 electrode to be formed on a substrate is not limited to a particular value, but, when the substrate is used as a light emitting plane, the thickness of the electrode is preferably within the range of from 1 nm to 300 nm, more preferably, within the range of from 5 to 200 nm so as to ensure transparency.

In a preferred embodiment ITO is used on a substrate having an ITO film thickness in the 15 range of from 10 nm (100 Å) to 1 µ (10000 Å), preferably from 20 nm (200 Å) to 500 nm (5000 Å). Generally, the sheet resistance of the ITO film is chosen in the range of not more than 100 Ω/cm², preferably not more than 50 Ω/cm².

Such anodes are commercially available from Japanese manufacturers, such as Geomatech Co.Ltd., Sanyo Vacuum Co. Ltd., Nippon Sheet Glass Co. Ltd.

20 As substrate either an electronconducting or electrically insulating material can be used. In case of using an electroconducting substrate, a light emitting layer or a positive hole transporting layer is directly formed thereupon, while in case of using an electrically insulating substrate, an electrode is firstly formed thereupon and then a light emitting layer or a positive hole transporting layer is superposed.

25 The substrate may be either transparent, semi-transparent or opaque. However, in case of using a substrate as an indicating plane, the substrate must be transparent or semi-transparent.

Transparent electrically insulating substrates are, for example, inorganic compounds such as glass, quartz and the like, organic polymeric compounds such as polyethylene, 30 polypropylene, polymethylmethacrylate, polyacrylonitrile, polyester, polycarbonate, polyvinylchloride, polyvinylalcohol, polyvinylacetate and the like. Each of these substrates can be transformed into a transparent electroconducting substrate by providing it with an electrode according to one of the methods described above.

Examples of semi-transparent electrically insulating substrates are inorganic compounds 35 such as alumina, YSZ (yttrium stabilized zirconia) and the like, organic polymeric compounds such as polyethylene, polypropylene, polystyrene, epoxy resins and the like. Each of these

substrates can be transformed into a semi-transparent electroconducting substrate by providing it with an electrode according to one of the abovementioned methods.

Examples of opaque electroconducting substrates are metals such as aluminum, indium, iron, nickel, zinc, tin, chromium, titanium, copper, silver, gold, platinum and the like, various electroplated metals, metallic alloys such as bronze, stainless steel and the like, semiconductors such as Si, Ge, GaAs, and the like, electroconducting polymers such as polyaniline, polythiophene, polypyrrole, polyacetylene, polyparaphenylene and the like.

A substrate can be obtained by forming one of the above listed substrate materials to a desired dimension. It is preferred that the substrate has a smooth surface. Even, if it has a rough surface, it will not cause any problem for practical use, provided that it has round unevenness having a curvature of not less than 20 µm. As for the thickness of the substrate, there is no restriction as far as it ensures sufficient mechanical strength.

As cathode usual cathode materials which possess low work function such as alkali metals, earth alkaline metals, group 13 elements, silver, and copper as well as alloys or mixtures thereof such as sodium, lithium, potassium, calcium, lithium fluoride (LiF), sodium-potassium alloy, magnesium, magnesium-silver alloy, magnesium-copper alloy, magnesium-aluminum alloy, magnesium-indium alloy, aluminum, aluminum-aluminum oxide alloy, aluminum-lithium alloy, indium, calcium, and materials exemplified in EP-A 499,011 such as electroconducting polymers e.g. polypyrrole, polythiophene, polyaniline, polyacetylene etc., preferably Mg/Ag alloys, LiF-Al or Li-Al compositions can be used.

In a preferred embodiment a magnesium-silver alloy or a mixture of magnesium and silver, or a lithium-aluminum alloy, lithium fluoride-aluminum alloy or a mixture of lithium and aluminum can be used in a film thickness in the range of from 10 nm (100 Å) to 1 µm (10000 Å), preferably from 20 nm (200 Å) to 500 nm (5000 Å).

Such cathodes can be deposited on the foregoing electron transporting layer by known vacuum deposition techniques described above.

In a preferred embodiment of this invention a light-emitting layer can be used between the hole transporting layer and the electron transporting layer. Usually the light-emitting layer is prepared by forming a thin film on the hole transporting layer.

As methods for forming said thin film, there are, for example, the vacuum deposition method, the spin-coating method, the casting method, the Langmuir-Blodgett ("LB") method and the like. Among these methods, the vacuum deposition method, the spin-coating method and the casting method are particularly preferred in view of ease of operation and cost.

In case of forming a thin film using a composition by means of the vacuum deposition method, the conditions under which the vacuum deposition is carried out are usually strongly

dependent on the properties, shape and crystalline state of the compound(s). However, optimum conditions are usually as follows: temperature of the heating boat: 100 to 400°C; substrate temperature: -100 to 350°C; pressure: 1.33×10^4 Pa (1×10^2 Torr) to 1.33×10^{-4} Pa (1×10^{-6} Torr) and deposition rate: 1 pm to 6 nm/sec.

5 In an organic EL element, the thickness of the light emitting layer is one of the factors determining its light emission properties. For example, if a light emitting layer is not sufficiently thick, a short circuit can occur quite easily between two electrodes sandwiching said light emitting layer, and therefor, no EL emission is obtained. On the other hand, if the light emitting layer is excessively thick, a large potential drop occurs inside the light emitting

10 layer because of its high electrical resistance, so that the threshold voltage for EL emission increases. Accordingly, the thickness of the organic light emitting layer is limited to the range of from 5 nm to 5 μ m, preferably to the range of from 10 nm to 500 nm.

In the case of forming a light emitting layer by using the spin-coating method and the casting method, ink jet printing method, the coating can be carried out using a solution prepared by

15 dissolving the composition in a concentration of from 0.0001 to 90% by weight in an appropriate organic solvent such as benzene, toluene, xylene, tetrahydrofuran, methyltetrahydrofuran, N,N-dimethylformamide, dichloromethane, dimethylsulfoxide and the like. If the concentration exceeds 90% by weight, the solution usually is so viscous that it no longer permits forming a smooth and homogenous film. On the other hand, if the

20 concentration is less than 0.0001% by weight, the efficiency of forming a film is too low to be economical. Accordingly, a preferred concentration of the composition is within the range of from 0.01 to 80% by weight.

In the case of using the above spin-coating or casting method, it is possible to further improve the homogeneity and mechanical strength of the resulting layer by adding a polymer

25 binder to the solution for forming the light emitting layer. In principle, any polymer binder may be used, provided that it is soluble in the solvent in which the composition is dissolved. Examples of such polymer binders are polycarbonate, polyvinylalcohol, polymethacrylate, polymethylmethacrylate, polyester, polyvinylacetate, epoxy resin and the like. However, if the solid content composed of the polymer binder and the composition exceeds 99% by weight,

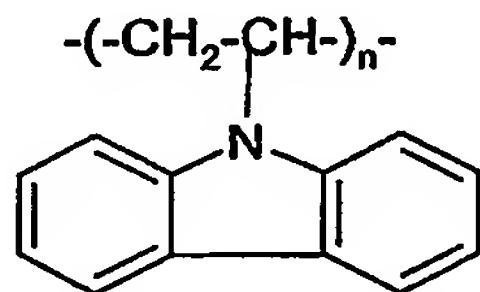
30 the fluidity of the solution is usually so low that it is impossible to form a light emitting layer excellent in homogeneity. On the other hand, if the content of the composition is substantially smaller than that of the polymer binder, the electrical resistance of said layer is very large, so that it does not emit light unless a high voltage is applied thereto. Accordingly, the preferred ratio of the polymer binder to the composition is chosen within the range of from 10:1 to 1:50

35 by weight, and the solid content composed of both components in the solution is preferably

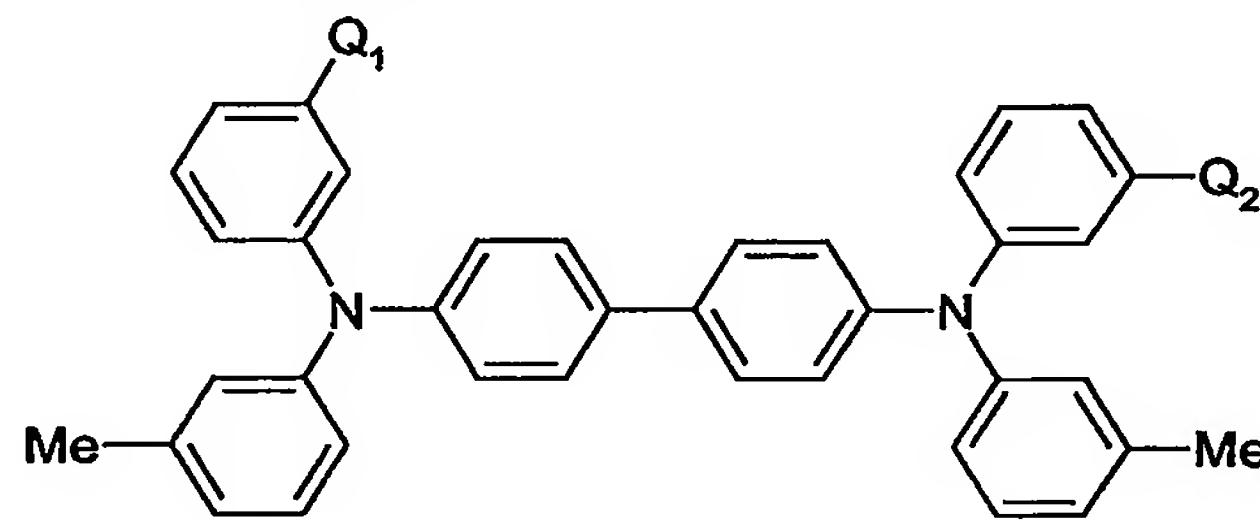
within the range of from 0.01 to 80% by weight, and more preferably, within the range of 0.1 to 60% by weight.

As hole-transporting layers known organic hole transporting compounds such as polyvinyl carbazole

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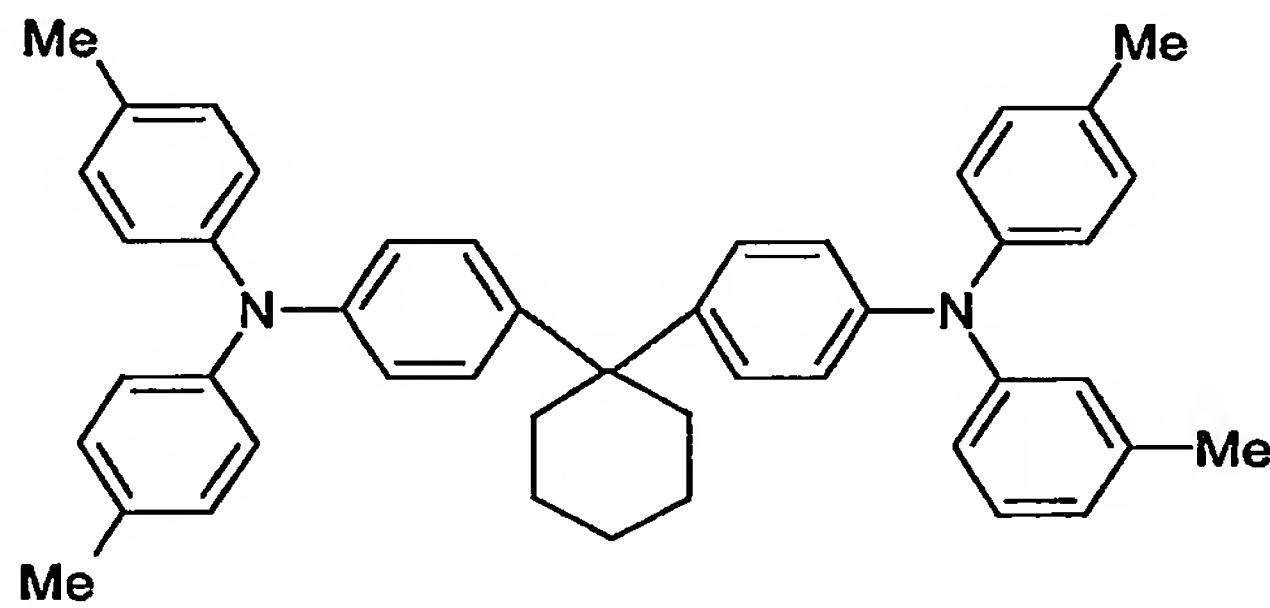


a TPD compound disclosed in J. Amer. Chem. Soc. 90 (1968) 3925:

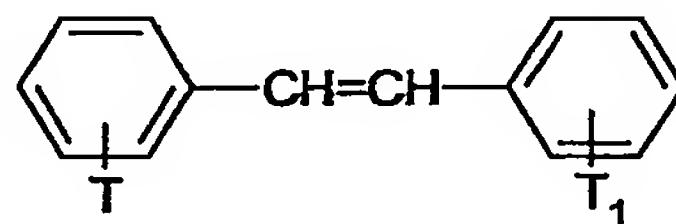


wherein Q₁ and Q₂ each represent a hydrogen atom or a methyl group;

10 a compound disclosed in J. Appl. Phys. 65(9) (1989) 3610:



a stilbene based compound



wherein T and T₁ stand for an organic radical;

15 a hydrazone based compound

$\begin{array}{c} R_x \equiv N-N-R_y \\ | \\ R_z \end{array}$, wherein Rx, Ry and Rz stand for an organic radical,

and the like can be used.



Compounds to be used as a positive hole transporting material are not restricted to the above listed compounds. Any compound having a property of transporting positive holes can be used as a positive hole transporting material such as triazole derivatives, oxadiazole derivatives, imidazole derivatives, polyarylalkane derivatives, pyrazoline derivative,
5 pyrazolone derivatives, phenylene diamine derivatives, arylamine derivatives, amino substituted chalcone derivatives, oxazole derivatives, stilbenylanthracene derivatives, fluorenone derivatives, hydrazone derivatives, stilbene derivatives, copolymers of aniline derivatives, PEDOT (poly (3,4-ethylenedioxy-thiophene)) and the derivatives thereof, electro-conductive oligomers, particularly thiophene oligomers, porphyrin compounds, aromatic
10 tertiary amine compounds, stilbenyl amine compounds etc.

Particularly, aromatic tertiary amine compounds such as N,N,N',N'-tetraphenyl-4,4'-diaminobiphenyl, N,N'-diphenyl-N,N'-bis(3-methylphenyl)- 4,4'-diaminobiphenyl (TPD), 2,2'-bis(di-p-torylaminophenyl)propane, 1,1'-bis(4-di-torylaminophenyl)-4-phenylcyclohexane, bis(4-dimethylamino-2-methylphenyl)phenylmethane, bis(4-di-p-tolylaminophenyl)phenylmethane, N,N'-diphenyl-N,N'-di(4-methoxyphenyl)-4,4'-diaminobiphenyl, N,N,N',N'-tetraphenyl-4,4'-diaminodiphenylether, 4,4'-bis(diphenylamino)quaterphenyl, N,N,N-tri(p-tolyl)amine, 4-(di-p-tolylamino)-4'-[4-(di-p-tolylamino)stilyl]stilbene, 4-N,N-diphenylamino-(2-diphenylvinyl)benzene, 3-methoxy-4'-N,N-diphenylaminostilbene, N-phenylcarbazole etc. are used.
15

20 Furthermore, 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl disclosed in US-B-5,061,569 and the compounds disclosed in EP-A 508,562, in which three triphenylamine units are bound to a nitrogen atom, such as 4,4',4"-tris[N-(3-methylphenyl)-N-phenylamino]triphenylamine, can be used.

A positive hole transporting layer can be formed by preparing an organic film containing at
25 least one positive hole transporting material on the anode. The positive hole transporting layer can be formed by the vacuum deposition method, the spin-coating method, the casting method, the ink jet printing method, the LB method and the like. Of these methods, the vacuum deposition method, the spin-coating method and the casting method are particularly preferred in view of ease and cost.

30 In the case of using the vacuum deposition method, the conditions for deposition may be chosen in the same manner as described for the formation of a light emitting layer (see above). If it is desired to form a positive hole transporting layer comprising more than one positive hole transporting material, the coevaporation method can be employed using the desired compounds.

In the case of forming a positive hole transporting layer by the spin-coating method or the casting method, the layer can be formed under the conditions described for the formation of the light emitting layer (see above).

As in the case of forming the light emitting layer a smoother and more homogeneous positive
5 hole transporting layer can be formed by using a solution containing a binder and at least one positive hole transporting material. The coating using such a solution can be performed in the same manner as described for the light emitting layer. Any polymer binder may be used, provided that it is soluble in the solvent in which the at least one positive hole transporting material is dissolved. Examples of appropriate polymer binders and of
10 appropriate and preferred concentrations are given above when describing the formation of a light emitting layer.

The thickness of the positive hole transporting layer is preferably chosen in the range of from 0.5 to 1000 nm, preferably from 1 to 100 nm, more preferably from 2 to 50 nm.

As hole injection materials known organic hole transporting compounds such as metal-free
15 phthalocyanine (H_2Pc), copper-phthalocyanine ($Cu-Pc$) and their derivatives as described, for example, in JP64-7635 can be used. Furthermore, some of the aromatic amines defined as hole transporting materials above, which have a lower ionisation potential than the hole transporting layer, can be used.

A hole injection layer can be formed by preparing an organic film containing at least one hole
20 injection material between the anode layer and the hole transporting layer. The hole injection layer can be formed by the vacuum deposition method, the spin-coating method, the casting method, the LB method and the like. The thickness of the layer is preferably from 5 nm to 5 μm , and more preferably from 10 nm to 100 nm.

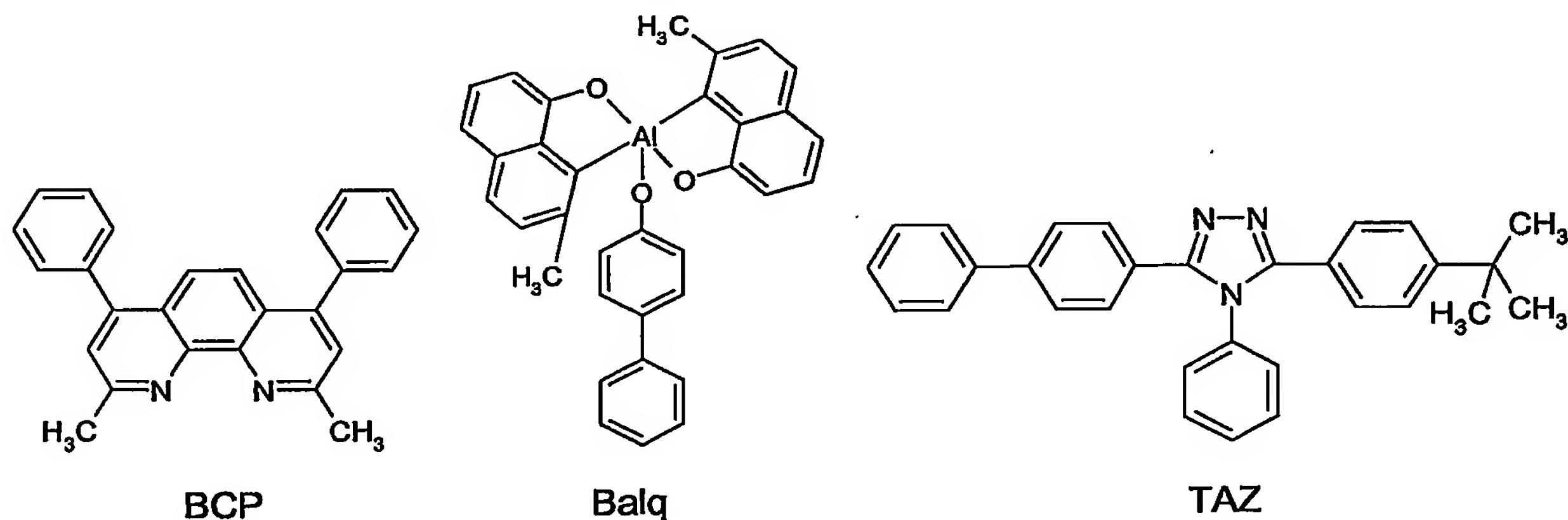
25 The electron transporting materials, which is for example a metal complex compound or a nitrogen-containing five-membered derivative, should have a high electron injection efficiency (from the cathode) and a high electron mobility. The following materials can be exemplified for electron transporting materials: lithium 8-hydroxyquinolate, zinc bis(8-hydroxyquinolate), copper bis(8-hydroxyquinolate), manganese bis(8-hydroxyquinolate), gallium tris(8-hydroxyquinolate), tris(8-hydroxyquinolato)-aluminum(III) and its derivatives, such as, for example, aluminum tris(2-methyl-8-hydroxyquinolate), bis(10-hydroxybenzo[h]quinolinolato)beryllium(II) and its derivatives, zinc bis(10-hydroxybenzo[h]quinolate), chlorogallium bis(2-methyl-8-quinolate), gallium bis(2-methyl-8-quinolate)(o-cresolate), aluminum bis(2-methyl-8-quinolate)(1-naphtholate), gallium bis(2-methyl-8-quinolate)(2-naphtholate), gallium bis(2-methyl-8-quinolate)phenolate, zinc bis(o-(2-benzooxazolyl)phenolate), zinc bis(o-(2-

benzothiazolyl)phenolate) and zinc bis(o-(2-benzotrizolyl)phenolate); oxadiazole derivatives, such as 2-(4-biphenyl)-5-(4-tert.-butylphenyl)-1,3,4-oxadiazole and 2,5-bis(1-naphthyl)-1,3,4-oxadiazole, and its dimer systems, such as 1,4-bis[2-(5-phenyloxadiazolyl)]benzene, 1,4-bis[2-(5-phenyloxadiazolyl)-4-tert-butylbenzene], 2,5-bis(1-phenyl)-1,3,4-oxadiazole, 2-(4'-tert-butylphenyl)-5-(4"-biphenyl)1,3,4-oxadiazole, 1,3-bis(4-tert.-butylphenyl-1,3,4)oxadiazolyl)biphenylene and 1,3-bis(4-tert.-butylphenyl-1,3,4-oxadiazolyl)phenylene, oxazole derivatives, dioxazole derivatives, thiazole derivatives, thiadiazole derivatives, triazole derivatives, such as 2,5-bis(1-phenyl)-1,3,4-oxazole, 1,4-bis(2-(4-methyl-5-phenyloxazolyl)benzene, 2,5-bis(1-phenyl)-1,3,4-thiazole, 2-(4'-tert-butylphenyl)-5-(4"-biphenyl)-1,3,4-thiadiazole, 2,5-bis(1-naphthyl)-1,3,4-thiadiazole, 1,4-bis[2-(5-phenylthiazolyl)]benzene, 2-(4'-tert-butylphenyl)-5-(4"-biphenyl)-1,3,4-triazole, or 2,5-bis(1-naphthyl)-1,3,4-triazole and 1,4-bis[2-(5-phenyltriazolyl)]benzene, coumarine derivatives, imidazopyridine derivatives, phenanthroline derivatives or perylene tetracarboxylic acid derivatives disclosed in Appl. Phys. Lett. 48 (2) (1986) 183.

15 An electron transporting layer can be formed by preparing an organic film containing at least one electron transporting material on the hole transporting layer or on the light-emitting layer. The electron transporting layer can be formed by the vacuum deposition method, the spin-coating method, the casting method, the LB method and the like.

20 It is preferred that the positive hole inhibiting materials for a positive hole inhibiting layer have high electron injection/transporting efficiency from the electron transporting layer to the light emission layer and also have higher ionisation potential than the light emitting layer to prevent the flowing out of positive holes from the light emitting layer to avoid a drop in luminescence efficiency.

25 As the positive hole inhibiting material known materials, such as Balq, TAZ and phenanthroline derivatives, e.g. bathocuproine (BCP), can be used:



The positive hole inhibiting layer can be formed by preparing an organic film containing at least one positive hole inhibiting material between the electron transporting layer and the light-emitting layer. The positive hole inhibiting layer can be formed by the vacuum deposition method, the spin-coating method, the casting method, ink jet printing method, the LB method 5 and the like. The thickness of the layer preferably is chosen within the range of from 5 nm to 2 μm, and more preferably, within the range of from 10 nm to 100 nm.

As in the case of forming a light emitting layer or a positive hole transporting layer, a smoother and more homogeneous electron transporting layer can be formed by using a solution containing a binder and at least one electron transporting material.

10 The thickness of an electron transporting layer is preferably chosen in the range of from 0.5 to 1000 nm, preferably from 1 to 100 nm, more preferably from 2 to 50 nm.

The hole-injecting material may be sensitivity-increased by incorporating an electron-accepting material, and the electron-injecting material may be sensitivity-increased by 15 incorporating an electron-donating material.

In the organic EL device of the present invention, the light-emitting layer may contain, in addition to the light-emitting 2H-benzotriazole material of the present invention, at least one of other light-emitting material, other dopant, other hole-injecting material and other electron-20 injecting material. For improving the organic EL device of the present invention in the stability against temperature, humidity and ambient atmosphere, a protective layer may be formed on the surface of the device, or the device as a whole may be sealed with a silicone oil, or the like.

The electrically conductive material used for the cathode is suitably selected from those 25 having a work function of smaller than 4 eV. The electrically conductive material includes magnesium, calcium, tin, lead, titanium, yttrium, lithium, ruthenium, manganese, aluminum and alloys of these, while the electrically conductive material shall not be limited to these.

Examples of the alloys include magnesium/silver, magnesium/indium and lithium/aluminum, while the alloys shall not be limited to these. Each of the anode and the cathode may have a 30 layer structure formed of two layers or more as required.

For the effective light emission of the organic EL device, at least one of the electrodes is desirably sufficiently transparent in the light emission wavelength region of the device. Further, the substrate is desirably transparent as well. The transparent electrode is 35 produced from the above electrically conductive material by a deposition method or a sputtering method such that a predetermined light transmittance is secured. The electrode on

the light emission surface side has for instance a light transmittance of at least 10%. The substrate is not specially limited so long as it has adequate mechanical and thermal strength and has transparency. For example, it is selected from glass substrates and substrates of transparent resins such as a polyethylene substrate, a polyethylene terephthalate substrate,
5 a polyether sulfone substrate and a polypropylene substrate.

In the organic EL device of the present invention, each layer can be formed by any one of dry film forming methods such as a vacuum deposition method, a sputtering method, a plasma method and an ion plating method and wet film forming methods such as a spin coating method, a dipping method and a flow coating method. The thickness of each layer is not specially limited, while each layer is required to have a proper thickness. When the layer thickness is too large, inefficiently, a high voltage is required to achieve predetermined emission of light. When the layer thickness is too small, the layer is liable to have a pinhole, etc., so that sufficient light emission brightness is hard to obtain when an electric field is applied. The thickness of each layer is for example in the range of from about 5 nm to about 10 μ m, for instance about 10 nm to about 0.2 μ m.
10
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In the wet film forming method, a material for forming an intended layer is dissolved or dispersed in a proper solvent such as ethanol, chloroform, tetrahydrofuran and dioxane, and a thin film is formed from the solution or dispersion. The solvent shall not be limited to the above solvents. For improving the film formability and preventing the occurrence of pinholes in any layer, the above solution or dispersion for forming the layer may contain a proper resin and a proper additive. The resin that can be used includes insulating resins such as polystyrene, polycarbonate, polyarylate, polyester, polyamide, polyurethane, polysulfone,
20
25 polymethyl methacrylate, polymethyl acrylate and cellulose, copolymers of these, photoconductive resins such as poly-N-vinylcarbazole and polysilane, and electroconducting polymers such as polythiophene and polypyrrole. The above additive includes an antioxidant, an ultraviolet absorbent and a plasticizer.

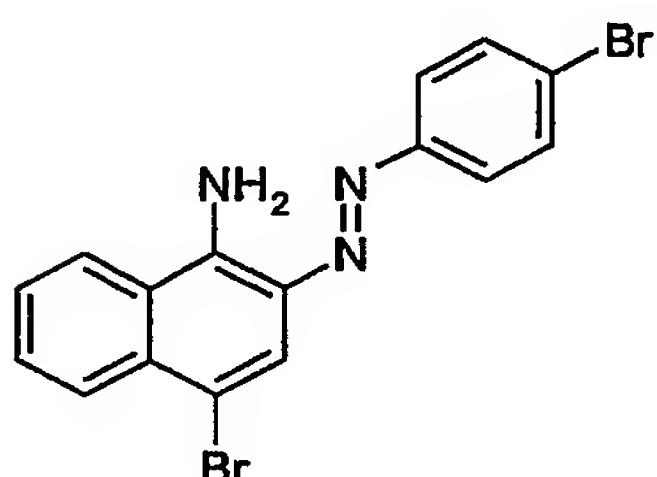
When the light-emitting benzotriazole material of the present invention is used in a light-emitting layer of an organic EL device, an organic EL device can be improved in organic EL device characteristics such as light emission efficiency and maximum light emission brightness. Further, the organic EL device of the present invention is remarkably stable against heat and electric current and gives a usable light emission brightness at a low actuation voltage. The problematic deterioration of conventional devices can be remarkably
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decreased.

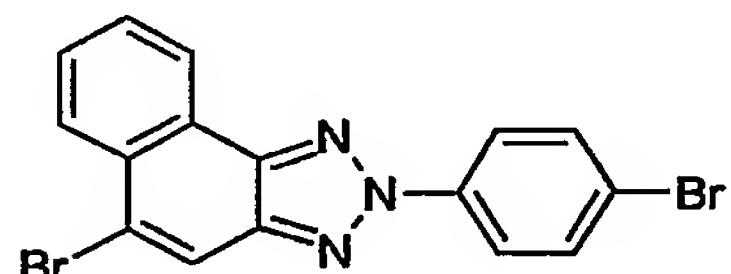
The following Examples illustrate the invention. In the Examples and throughout this application, the term light emitting material means the present 2H-benzotriazole compounds.

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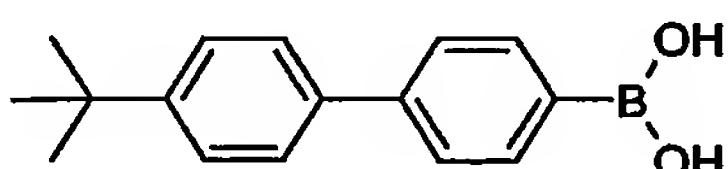
Example 1



a) 4-Bromoaniline (58.14 mmol) is dissolved in 200 ml water using 174 mmol HCl. The mixture is cooled to 0°C and sodium nitrite (58.1 mmol) in 30 ml water is added dropwise over 30 minutes. After 45 minutes the diazonium salt is added via cannula to a mixture of 1-amino-4-bromonaphthalene (58.14 mmol) in 300 ml ethanol at 0°C. After 2 hours sodium carbonate (80.2 mmol) in 100 ml water is added dropwise, producing a pH of 7. After an additional 30 minutes the red precipitate is filtered and washed with water (2 x 300 ml). The brown-red solid was triturated in 100 ml methanol overnight, filtered and dried. The product was dried in vacuo to give a bright red solid (yield: 91%). ^1H NMR (ppm, $(\text{CD}_3)_2\text{SO}$): 8.59 (d, 1H), 8.12 (s, 1H), 8.07 (d, 1H), 8.04 (d, 2H), 7.82 (d, 1H), 7.76 (d, 2H), 7.70 (t, 1H).



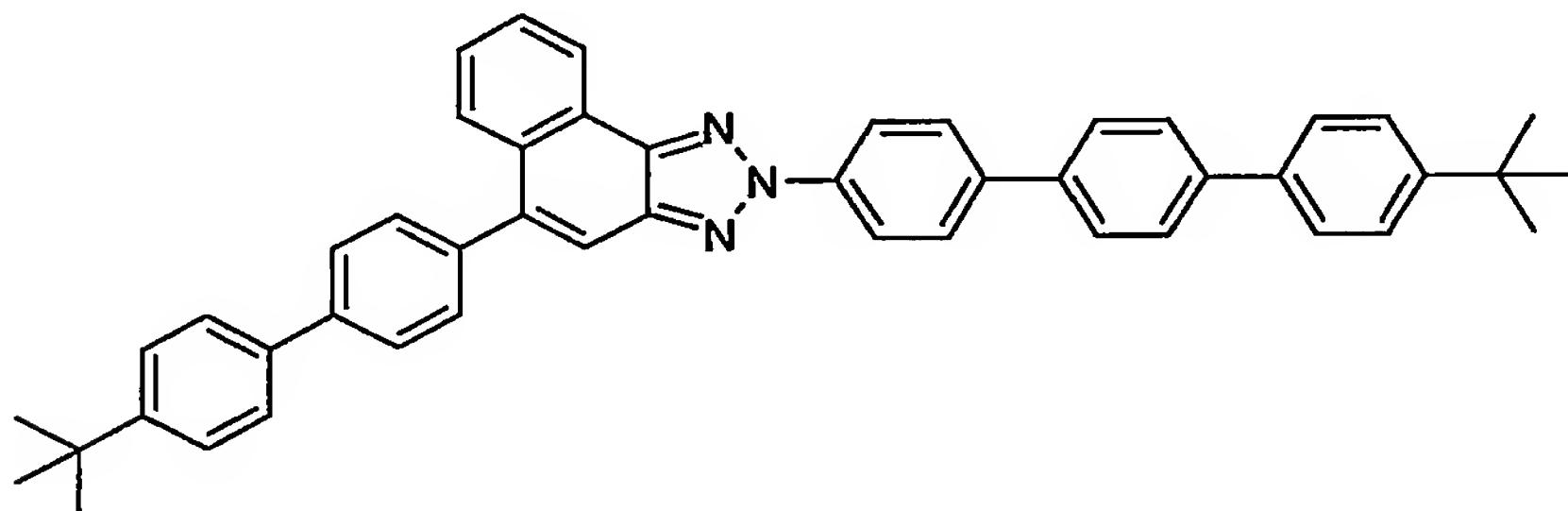
b) The product from step a) (49.37 mmol) and copper(II) acetate (0.49 mmol) are placed in a 250 ml flask with a stir bar. 250 ml tert-amyl alcohol are added and the mixture is heated to 80°C. tert-Butyl hydroperoxide, (98.7 mmol) is slowly added and the reaction is monitored by TLC. The flask is cooled to room temperature and the product is filtered. Washing with tert-amyl alcohol and removal of volatiles in vacuo give a light brown solid. The product is triturated in 30 ml methanol overnight, filtered and dried to give an off-white solid (yield: 77%). ^1H NMR (ppm, CDCl_3): 8.47 (m, 1H), 8.20 (d, 1H), 8.08 (d, 2H), 8.01 (s, 1H), 7.58 (m, 2H), 7.49 (d, 2H).



c) Magnesium turnings (68.7 mmol) are dry stirred under argon for one hour. 32 ml ether are added, followed by 2 drops of dibromoethane. 4-Bromo-4'-tert-butylbiphenyl (Murphy, S., et.

al. *J. Org. Chem.* **1995**, *60*, 2411) (34.6 mmol) in 20 ml ether and 25 ml THF is added dropwise over 1 hour. The mixture is refluxed for 2 hours at 37°C. In a separate flask triisopropylborate (41 mmol) and 30 ml THF are cooled to -78°C under argon. The above Grignard reagent is added via cannula and the reaction is allowed to stir at -78°C for 1 hour.

5 The flask is warmed to room temperature and stirred for an additional hour. The mixture is poured into a flask containing HCl/water and is stirred for 2 hours. The beige product is filtered and washed with water. Removal of volatiles in vacuo give an off-white solid (yield: 64%). $T_m = 192^\circ\text{C}$. ^1H NMR (ppm, $(\text{CD}_3)_2\text{SO}$): 7.80 (d, 2H), 7.55 (two overlapping doublets, 4H), 7.41 (d, 2H), 1.25 (s, 9H).

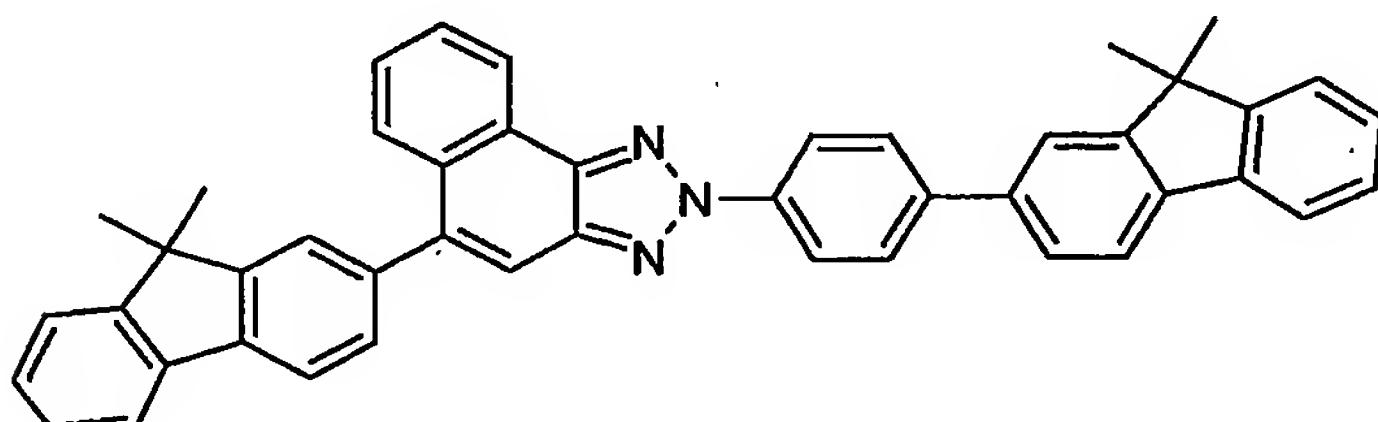


(A-1)

10 d) The product from step b) (0.94 mmol), the product from step c) (2.83 mmol), palladium tetrakis(triphenylphosphine) (8.6 μmol) and 10 ml N,N-dimethylacetamide are placed in a 100 ml flask and purged with argon for 2 hours. Tetraethylammonium hydroxide (20% in water) is placed in a 50 ml flask and purged with argon for 2 hours. Then 2.0 ml of the base solution (2.8 mmol) are added to the first flask under argon. The mixture is heated to 100°C overnight and cooled. TLC showed one spot (hexanes:ethyl acetate, 1:1). 20 ml water are added and the product is removed via filtration. Washing with 20 ml water, followed by 20 ml methanol and drying in vacuo give a tan solid (yield: 87%). The product was subsequently purified using zone sublimation. MS (EI): 662 (M+1).

20

Example 2



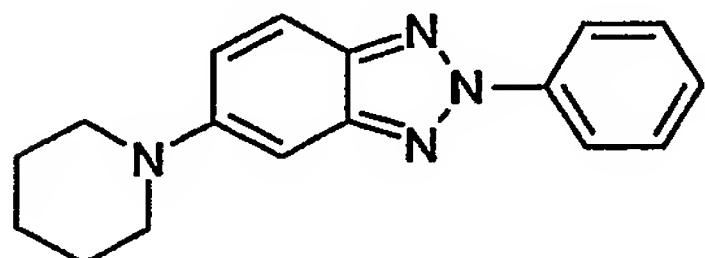
(A-8)

25 The product from example 1b) (2.48 mmol), 9,9-dimethylfluorene-2-boronic acid (EP-A-1238981, 7.44 mmol), palladium tetrakis(triphenylphosphine) (22 μmol), and 25 ml N,N-dimethylacetamide are placed in a 100 ml flask and purged with argon for 2 hours. Tetraethylammonium hydroxide (20% in water) is placed in a 50 ml flask and purged with

argon for 2 hours. Then 5.3 ml of the base solution (7.5 mmol) are added to the first flask under argon. The mixture is heated to 100°C overnight and cooled. 50 ml water are added and the product is removed via filtration. Washing with 100 ml water, followed by 30 ml methanol and drying in vacuo give a tan solid (yield: 90%). The product is subsequently purified using zone sublimation. MS (EI): 630 (M+1).

5

Example 3

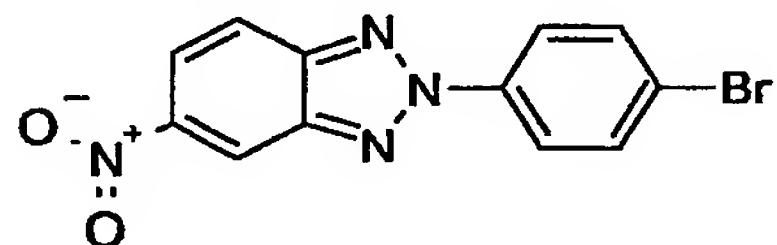


(B-2)

10 5-Amino-2-phenyl-2H-benzotriazole (Kehrmann, et. al., *Chem. Ber.* **1892**, *25*, 899.) (23.8 mmol), and potassium carbonate (52.3 mmole) are placed in a 250 ml flask with 50 ml DMF and a stir bar. While stirring, 1,5-dibromopentane (26.2 mmol) is added via syringe. The mixture is heated to 100°C for 25 hours. The flask is cooled and the product is extracted using water:dichloromethane. Washing with water and extraction followed by removal of volatiles in vacuo give a dark yellow-green solid. The material is chromatographed using 19:1 hexanes:ethyl acetate (yield: 55%). $T_m = 143^\circ\text{C}$. ^1H NMR (ppm, CDCl_3): 8.30 (d, 2H), 7.78 (d, 1H), 7.54 (m, 2H), 7.45 (t, 1H), 7.30 (d, 2H), 7.13 (s, 1H), 3.26 (m, 4H), 1.80 (m, 4H), 1.67 (m, 2H). The material has a λ_{max} emission of 458 nm in toluene, which corresponds to a color point of CIE (0.139, 0.116).

15

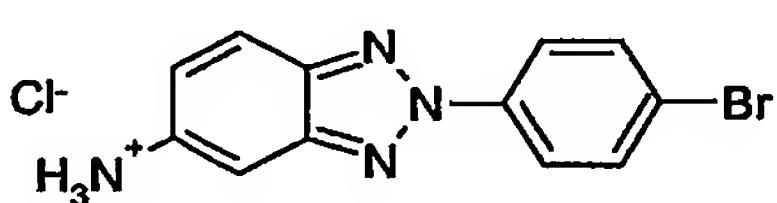
20 Example 4



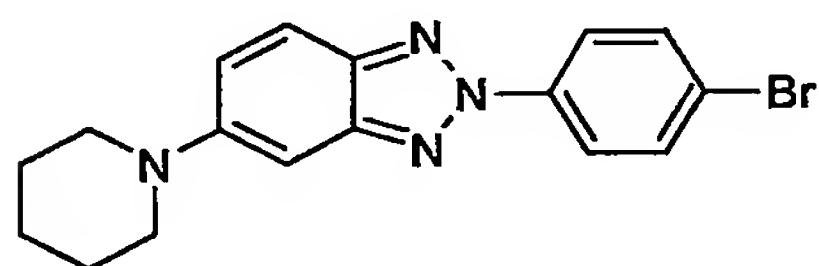
a) Bromophenylhydrazine hydrochloride (0.231 mol), 1-chloro-2,4-dinitrobenzene (0.115 mol) and sodium acetate trihydrate (0.346 mol) are placed in a 1 l reactor. 200 ml Ethanol are added and the mixture is heated to reflux for 6 hours. The mixture is cooled to room temperature and the product is removed by filtration. The material is washed with methanol, water and then methanol again. Volatiles are removed in vacuo to give a light brown solid (yield: 54%). $T_m = 201^\circ\text{C}$. ^1H NMR (ppm, CDCl_3): 8.94 (d, 1H), 8.30 (overlapping d and dd, 3H), 8.07 (d, 1H), 7.74 (d, 2H).

25

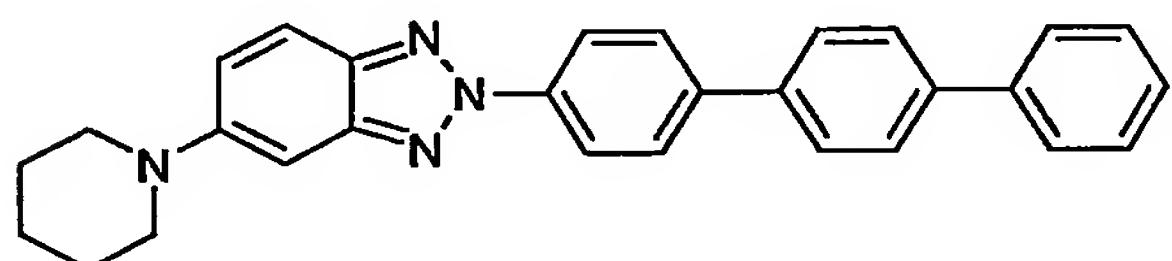
30



b) The product from example 4a (46.69 mmol) and 200 ml ethanol are placed in a 350 ml reactor. Raney nickel, 8 mL of a 70% slurry, is added. Hydrazine hydrate (0.226 mol) is added in portions over 12 hours with vigorous stirring. After an additional 5 hours at room temperature, the product is filtered and washed with methanol. The material is slurried in 200 ml water and 120 ml concentrated hydrochloric acid (1.44 mol) are added slowly. After stirring for 20 hours, the product is filtered and washed with water. Washing with methanol and removal of volatiles in vacuo give a tan solid (yield: 67%). ^1H NMR (ppm, $\text{OS}(\text{CD}_3)_2$): 8.19 (d, 2H), 7.97 (d, 1H), 7.83 (d, 2H), 7.45 (d, 1H), 7.28 (dd, 1H).



c) The product from example 4b (15.4 mmol) and potassium carbonate (46.5 mmol) are placed in a 250 ml flask with 60 ml DMF. While stirring, 1,5-dibromopentane (19.8 mmol) is added via syringe. The mixture is heated to 100°C for 2 hours. Additional 1,5-dibromopentane (7.4 mmol) is added via syringe. Heating is continued for 20 hours. The product is extracted using dichloromethane-water and washed with water. The product is dried over silica and chromatographed using 19:1 hexanes:ethyl acetate. The material is isolated as a yellow solid (yield: 46%). ^1H NMR (ppm, CDCl_3): 8.18 (d, 2H), 7.75 (d, 1H), 7.65 (d, 2H), 7.30 (d, 1H), 7.08 (s, 1H), 3.25 (m, 4H), 1.79 (m, 4H), 1.65 (m, 2H).



(B-1)

d) The product from step 4c) (4.20 mmol), 4-biphenylboronic acid (2.83 mmol), palladium tetrakis(triphenylphosphine) (35 mmol) and 25 ml N,N-dimethylacetamide are placed in a 100 ml flask and purged with argon for 2 hours. Tetraethylammonium hydroxide, 20% in water, is placed in a 50 mL flask and purged with argon for 2 hours. Then, 4.6 mL of the base solution (6.5 mmol) are added to the first flask under argon. The mixture is heated to 100°C overnight and cooled. TLC showed two spots (hexanes:ethyl acetate, 1:1). 20 ml Water are added and the product is removed via filtration. Washing with water (20 ml), followed by methanol (20 ml), and drying in vacuo give a yellow solid (yield: 85%). $T_m = 213^\circ\text{C}$. The product is subsequently purified using zone sublimation. MS (EI): 431 (M+1).

The following device structure is prepared: ITO/CuPC/NPD/Compound A-1/TPBI/LiF/AI where ITO is indium tin oxide, CuPC is copper phthalocyanine, NPD is 4,4'-bis-(1-naphthyl-phenylamino) biphenyl, and TPBI is 1,3,5-tris-(N-phenyl-benzimidazol-2-yl) benzene. Using this device structure, a maximum brightness of 2200 cd/m² is observed at a maximum efficiency of 0.67 cd/A with an emission λ_{max} at 450 nm.

5

Application Example 2 (Device)

The following device structure is prepared: ITO/CuPC/NPD/Compound A-8/TPBI/LiF/AI. Using this device structure, a maximum brightness of 3400 cd/m² is observed at a maximum efficiency of 0.83 cd/A with an emission λ_{max} at 467 nm.

10

Application Example 3 (Device)

The following device structure is prepared: ITO/CuPC/NPD/Compound A-1 + Compound B-2 (2.3 % by weight)/TPBI/LiF/AI. Using this device structure, a maximum brightness of 6800 cd/m² is observed at a maximum efficiency of 1.6 cd/A with an emission at CIE (0.148, 0.122).

15

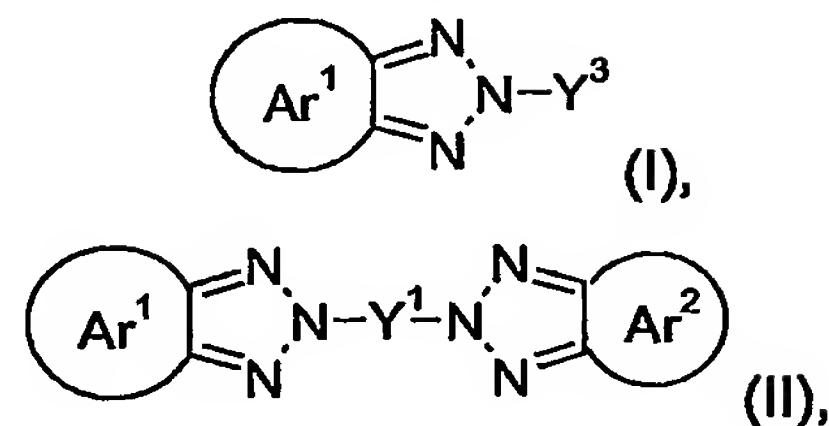
Application Example 4 (Device)

The following device structure is prepared: ITO/CuPC/NPD/Compound A-1 + Compound B-1 (1.6 % by weight)/TPBI/LiF/AI. Using this device structure, a maximum brightness of 7600 cd/m² is observed at a maximum efficiency of 1.6 cd/A with an emission at CIE (0.161, 0.131).

20

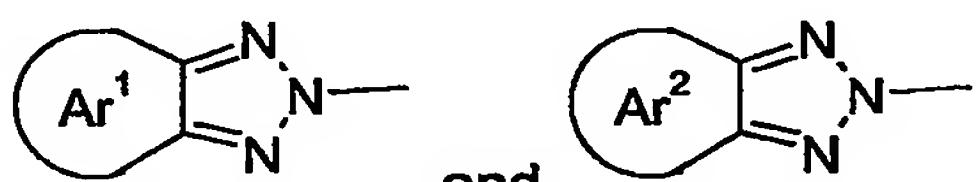
Claims

1. A 2H-benzotriazole compound of the formula

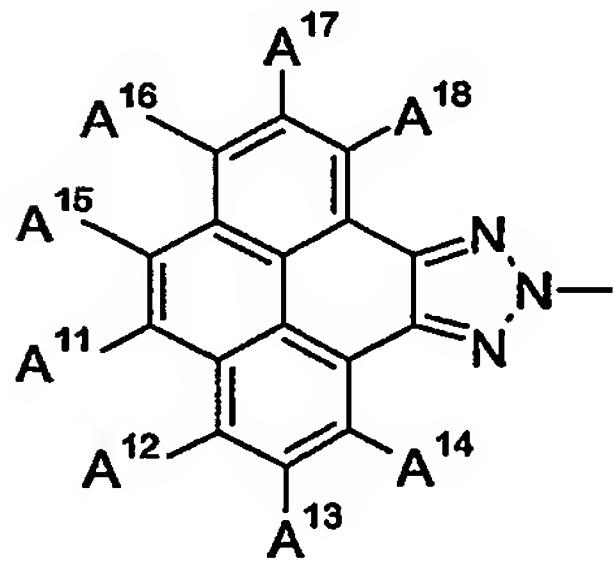
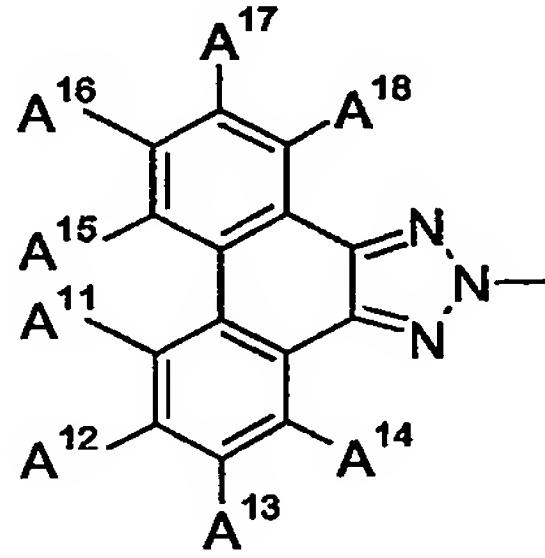
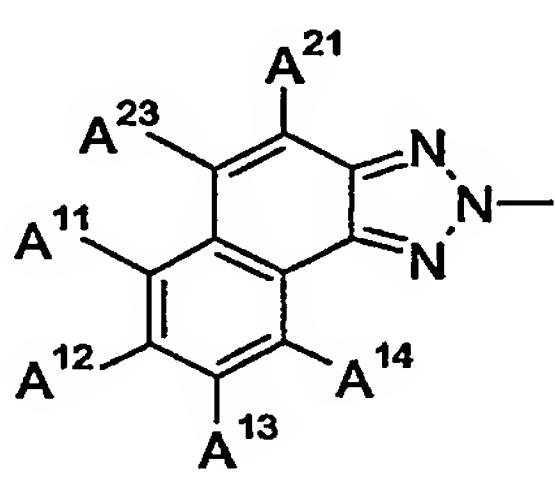
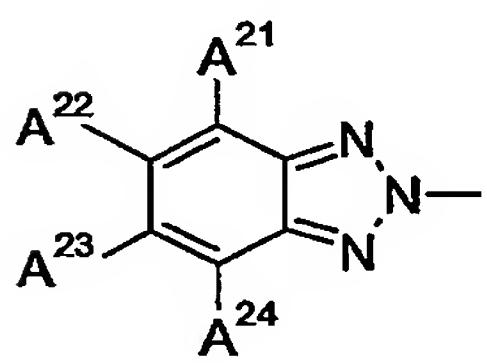


Y^1 is a divalent linking group, and

Y^3 is C₁-C₂₅alkyl, especially C₁-C₄alkyl, aryl or heteroaryl, which can optionally be substituted, especially C₆-C₃₀aryl, or a C₂-C₂₆heteroaryl, which can optionally be substituted.



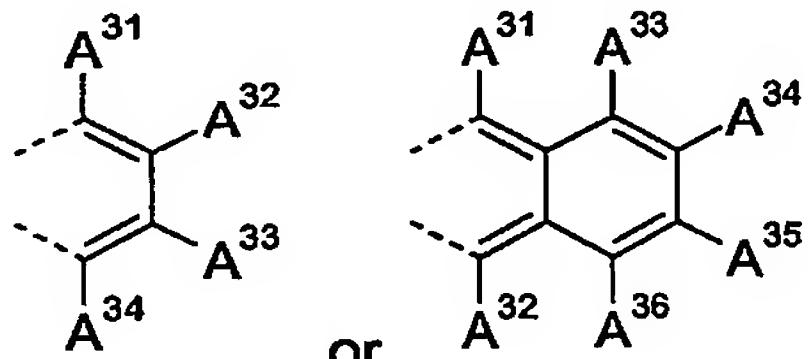
N and **N** are independently of each other a group of formula



, wherein

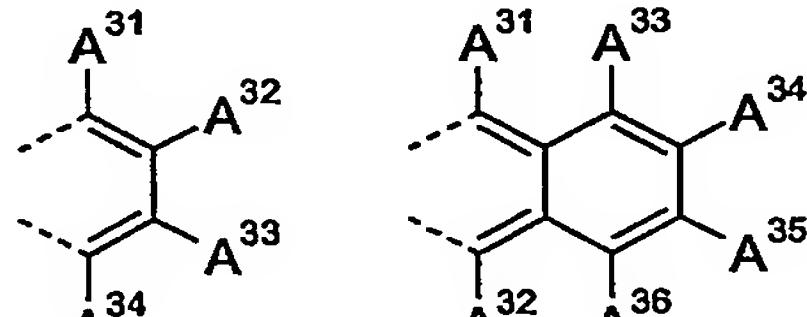
15 A²¹, A²², A²³, A²⁴, A¹¹, A¹², A¹³, A¹⁴, A¹⁵, A¹⁶, A¹⁷ and A¹⁸ are independently of each other
H, halogen, especially fluorine, hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by
E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially
pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or
interrupted by S-, -O-, or -NR²⁵-, -NR²⁵R²⁶, C₁-C₂₄alkylthio, -PR³² R³², C₅-
20 C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl
which is substituted by G, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-

C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl; C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, fluorine, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl; C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by G, or -CO-R²⁸, or



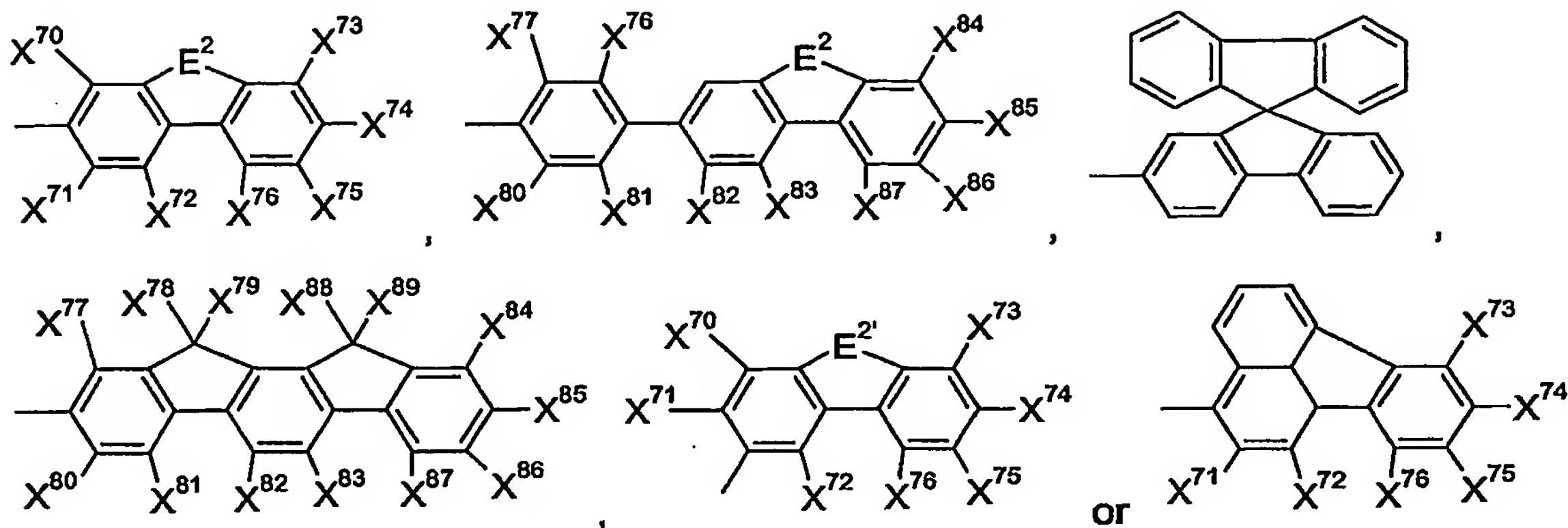
A²² and A²³ or A¹¹ and A²³ are a group , or , or

two groups A¹¹, A¹², A¹³, A¹⁴, A¹⁵, A¹⁶, A¹⁷ and A¹⁸, which are neighbouring to each



other, are a group , or , wherein A³¹, A³², A³³, A³⁴, A³⁵ and A³⁶ are independently of each other H, halogen, hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by G, or -CO-R²⁸, wherein preferably at least one of the substituents A²¹,

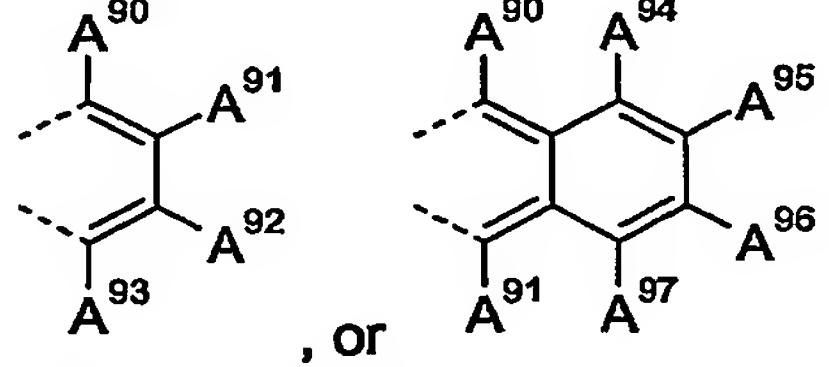
A²², A²³, A²⁴, A¹¹, A¹², A¹³, A¹⁴, A¹⁵, A¹⁶, A¹⁷ and A¹⁸ is C₆-C₂₄aryl which is substituted by fluorine, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl; or C₂-C₂₆heteroaryl, especially thiophenyl, pyrrolyl, furanyl, benzoxazolyl, or benzothiazolyl, which is substituted by fluorine, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl, or



wherein X⁷⁰, X⁷¹, X⁷², X⁷³, X⁷⁴, X⁷⁵, X⁷⁶, X⁷⁷, X⁸⁰, X⁸¹, X⁸², X⁸³, X⁸⁴, X⁸⁵, X⁸⁶, and X⁸⁷ are independently of each other E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-

5 C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which
is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, -NR²⁵R²⁶, C₁-C₂₄alkylthio,
-PR³²R³², C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl,
C₆-C₂₄aryl which is substituted by G, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-
C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl;
10 C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, fluorine, C₁-C₂₄alkyl, C₅-
C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially
pentafluorophenyl, or C₁-C₂₄haloalkyl; C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-
C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-
C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is
15 substituted by G, or -CO-R²⁸, or
two groups X⁷⁰, X⁷¹, X⁷², X⁷³, X⁷⁴, X⁷⁵, X⁷⁶, X⁷⁷, X⁸⁰, X⁸¹, X⁸², X⁸³, X⁸⁴, X⁸⁵, X⁸⁶, and X⁸⁷,

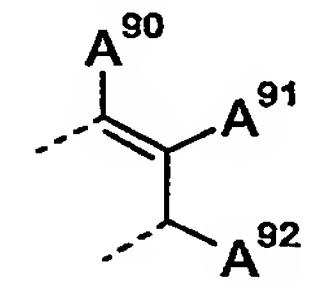
two groups $X^{70}, X^{71}, X^{72}, X^{73}, X^{74}, X^{75}, X^{76}, X^{77}, X^{80}, X^{81}, X^{82}, X^{83}, X^{84}, X^{85}, X^{86}$, and X^{87} ,



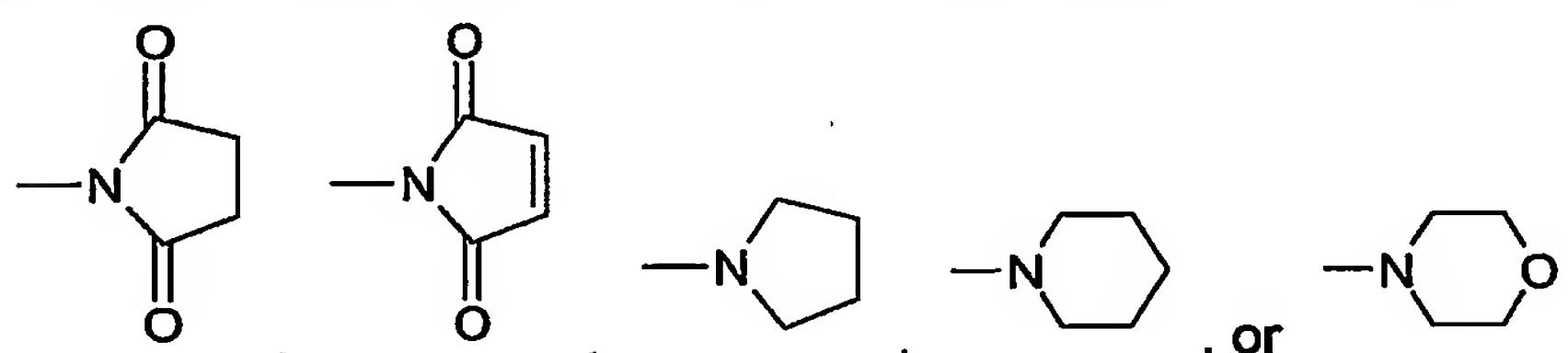
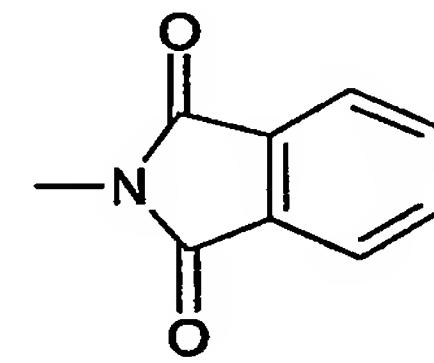
which are neighbouring to each other, are a group A^{90} , or $A^{91} A^{92}$, wherein $A^{90}, A^{91}, A^{92}, A^{93}, A^{94}, A^{95}, A^{96}$ and A^{97} are independently of each other H,

and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially
pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or
interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is
substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-
C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-
C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-

C_{25} aralkyl, which is substituted by G, C_7 - C_{25} aralkoxy, C_7 - C_{25} aralkoxy which is substituted by G, or $-CO-R^{28}$,
 E^2 is $-CR^{23}=CR^{24}-$, especially $-CX^{68}X^{69}-$,
 E^2 is $-SiR^{30}R^{31}-$; $-POR^{32}-$; especially $-S-$, $-O-$, or $-NR^{25}-$, wherein R^{25} is C_1 - C_{24} alkyl, or
5 C_6 - C_{10} aryl,
 X^{68} , X^{69} , X^{78} , X^{79} , X^{88} and X^{89} are independently of each other C_1 - C_{18} alkyl, C_1 - C_{24} alkyl which is substituted by E and/or interrupted by D, C_6 - C_{24} aryl, C_6 - C_{24} aryl which is substituted by G, C_2 - C_{20} heteroaryl, C_2 - C_{20} heteroaryl which is substituted by G, C_2 - C_{24} alkenyl, C_2 - C_{24} alkynyl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkoxy which is substituted by E and/or interrupted by D, or C_7 - C_{25} aralkyl, or
10 X^{78} and X^{79} , and/or X^{88} and X^{89} form a ring, especially a five- or six-membered ring, or



X^{68} and X^{70} , X^{69} and X^{73} , X^{77} and X^{78} and/or X^{84} and X^{89} are a group,
D is $-CO-$; $-COO-$; $-S-$; $-SO-$; $-SO_2-$; $-O-$; $-NR^{25}-$; $-SiR^{30}R^{31}-$; $-POR^{32}-$; $-CR^{23}=CR^{24}-$; or $-C\equiv C-$; and
15 E is $-OR^{29}$; $-SR^{29}$; $-NR^{25}R^{26}$; $-COR^{28}$; $-COOR^{27}$; $-CONR^{25}R^{26}$; $-CN$; $-OCOOR^{27}$; or halogen;
G is E, or C_1 - C_{24} alkyl, wherein
 R^{23} , R^{24} , R^{25} and R^{26} are independently of each other H; C_6 - C_{18} aryl; C_6 - C_{18} aryl which is substituted by C_1 - C_{24} alkyl, or C_1 - C_{24} alkoxy; C_1 - C_{24} alkyl; or C_1 - C_{24} alkyl which is interrupted by $-O-$; or
20 R^{25} and R^{26} together form a five or six membered ring, in particular

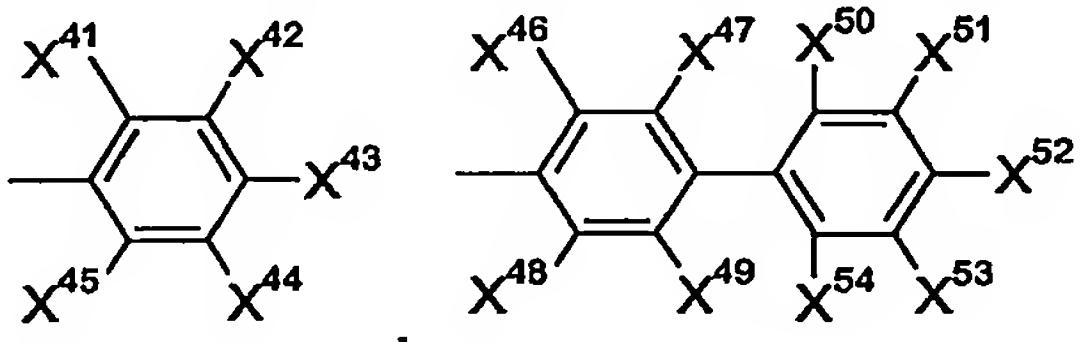


R^{27} and R^{28} are independently of each other H; C_6 - C_{18} aryl; C_6 - C_{18} aryl which is substituted by C_1 - C_{24} alkyl, or C_1 - C_{24} alkoxy; C_1 - C_{24} alkyl; or C_1 - C_{24} alkyl which is interrupted by $-O-$,
25 R^{29} is H; C_6 - C_{18} aryl; C_6 - C_{18} aryl, which is substituted by C_1 - C_{24} alkyl, or C_1 - C_{24} alkoxy; C_1 - C_{24} alkyl; or C_1 - C_{24} alkyl which is interrupted by $-O-$,

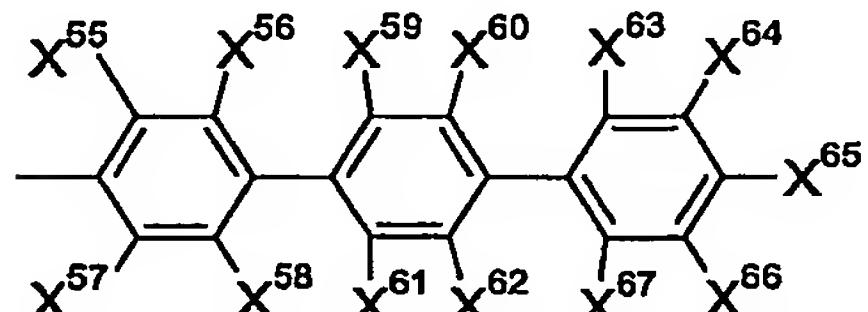
R^{30} and R^{31} are independently of each other C_1 - C_{24} alkyl, C_6 - C_{18} aryl, or C_6 - C_{18} aryl, which is substituted by C_1 - C_{24} alkyl, and

R^{32} is C_1 - C_{24} alkyl, C_6 - C_{18} aryl, or C_6 - C_{18} aryl, which is substituted by C_1 - C_{24} alkyl.

5 2. A 2H-benzotriazole compound according to claim 1, wherein at least one of the substituents A^{21} , A^{22} , A^{23} , A^{24} , A^{11} , A^{12} , A^{13} , A^{14} , A^{15} , A^{16} , A^{17} and A^{18} , especially A^{12} , A^{21}



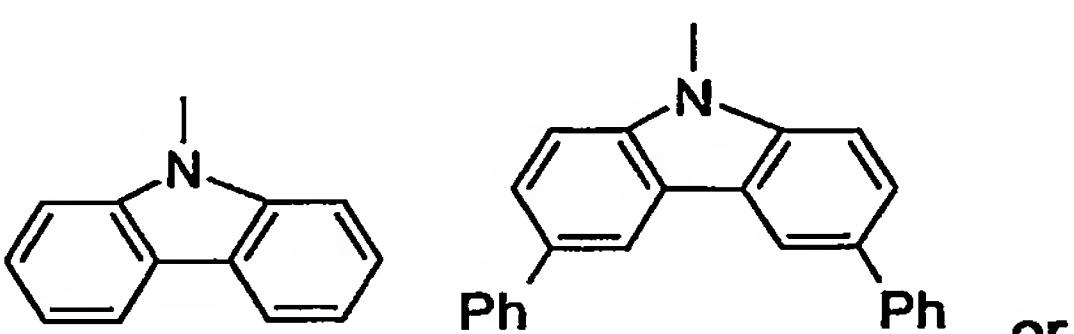
and/or A^{23} , are a group of formula



, wherein X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} are

10 independently of each other H, fluorine, $-NR^{25}R^{26}$, C_1 - C_{24} alkyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, or C_1 - C_{24} haloalkyl, C_1 - C_{24} alkyl, which is optionally substituted by E and/or interrupted by D, C_1 - C_{24} alkenyl, which is optionally substituted by E, C_5 - C_{12} cycloalkyl, which is optionally substituted by G, C_5 - C_{12} cycloalkoxy, which is optionally substituted by G, C_6 - C_{18} aryl, which is optionally substituted by G, C_1 - C_{24} alkoxy, which is optionally substituted by E and/or interrupted by D, C_6 - C_{18} aryloxy, which is optionally substituted by G, C_7 - C_{18} arylalkoxy, which is optionally substituted by G, C_1 - C_{24} alkylthio, which is optionally substituted by E and/or interrupted by D, C_2 - C_{20} heteroaryl which is substituted by G, or C_6 - C_{18} aralkyl, which is optionally substituted by G, or

15 X^{43} , X^{65} or X^{52} are a group of formula

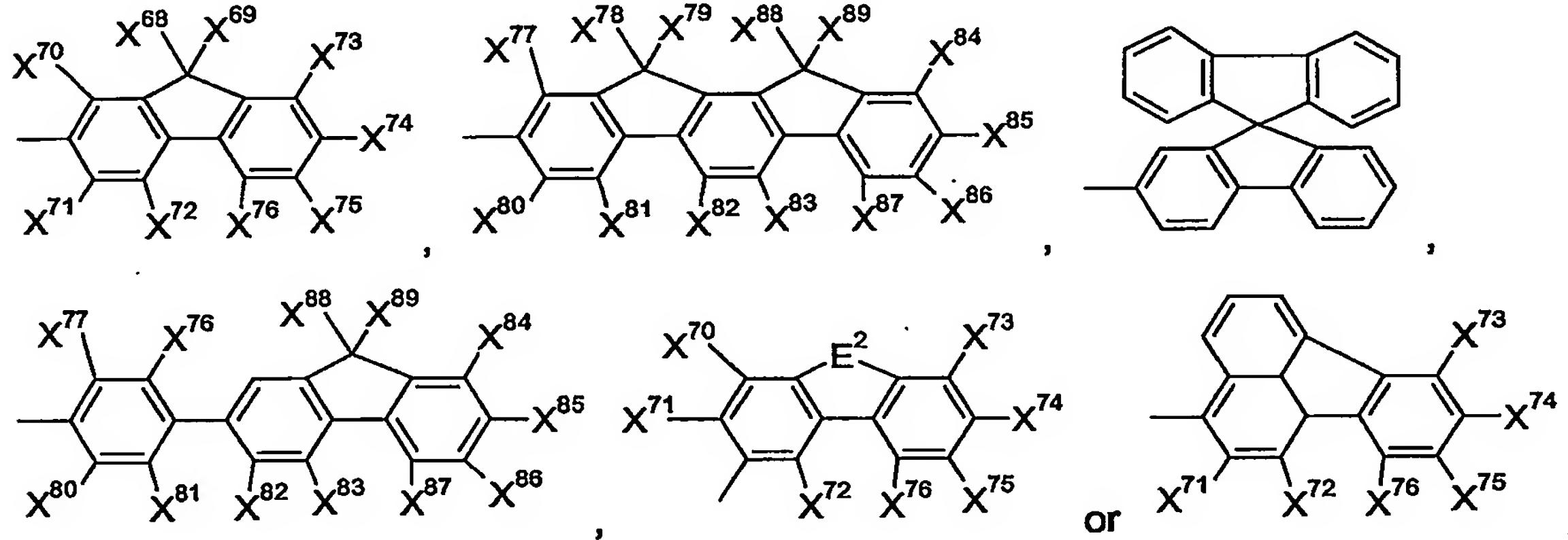


20 X^{43} , X^{65} or X^{52} are a group of formula , Ph , or two groups X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} , which are neighbouring to each other,

are a group , or , where A^{90} , A^{91} , A^{92} , A^{93} , A^{94} , A^{95} , A^{96} and A^{97} are independently of each other H, halogen, hydroxy, C_1 - C_{24} alkyl, C_1 - C_{24} alkyl which

is substituted by E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by E, or -CO-R²⁸, wherein R²⁵, R²⁶ and R²⁸, D, E and G are as defined in claim 2 and preferably at least one of the substituents X⁴¹, X⁴², X⁴³, X⁴⁴, X⁴⁵, X⁴⁶, X⁴⁷, X⁴⁸, X⁴⁹, X⁵⁰, X⁵¹, X⁵², X⁵³, X⁵⁴, X⁵⁵, X⁵⁶, X⁵⁷, X⁵⁸, X⁵⁹, X⁶⁰, X⁶¹, X⁶², X⁶³, X⁶⁴, X⁶⁵, X⁶⁶ and X⁶⁷ is fluorine, -NR²⁵R²⁶, C₁-C₂₄alkyl, C₅-C₁₂cycloalkyl, C₇-C₂₅aralkyl, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, or C₁-C₂₄haloalkyl.

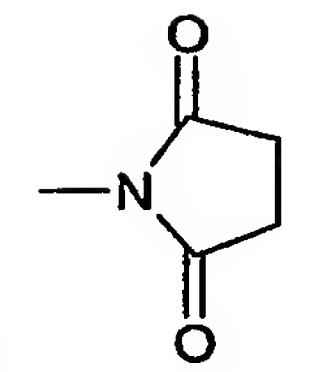
3. A 2H-benzotriazole compound according to claim 1, wherein at least one of the substituents A²¹, A²², A²³, A²⁴, A¹¹, A¹², A¹³, A¹⁴, A¹⁵, A¹⁶, A¹⁷ and A¹⁸, especially A¹² and/or A²³ are a group of formula



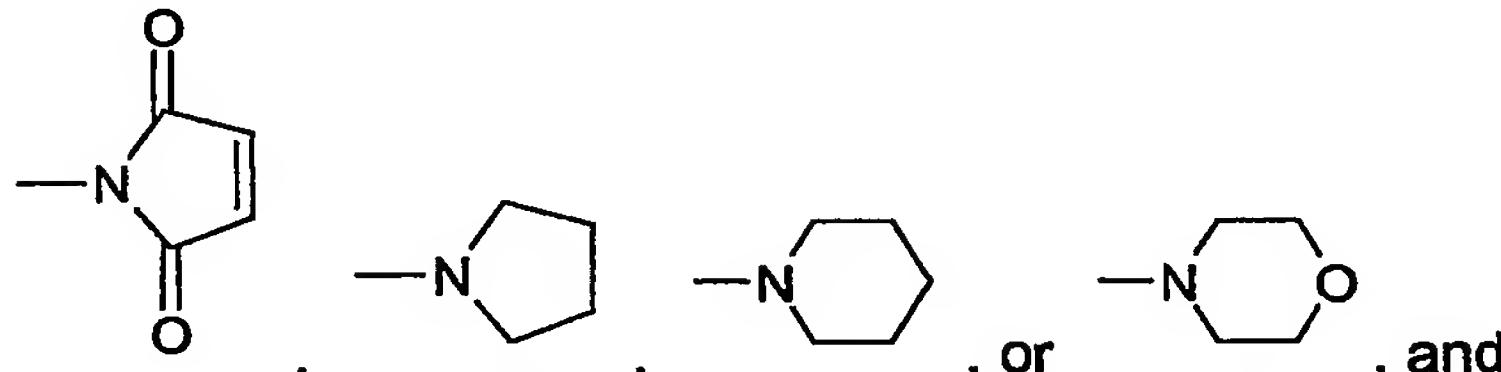
wherein

X⁶⁸, X⁶⁹, X⁷⁸, X⁷⁹, X⁸⁸ and X⁸⁹ are independently of each other C₁-C₂₄alkyl, especially C₁-C₁₂alkyl, which can be interrupted by one or two oxygen atoms, X⁷⁰, X⁷¹, X⁷², X⁷³, X⁷⁴, X⁷⁵, X⁷⁶, X⁷⁷, X⁸⁰, X⁸¹, X⁸², X⁸³, X⁸⁴, X⁸⁵, X⁸⁶ and X⁸⁷ are independently of each other H, CN, C₁-C₂₄alkyl, C₆-C₁₀aryl, C₁-C₂₄alkoxy, C₁-C₂₄alkylthio, -NR²⁵R²⁶, -CONR²⁵R²⁶, or -COOR²⁷, wherein

R²⁵ and R²⁶ are independently of each other H, C₆-C₁₈aryl, C₇-C₁₈aralkyl, or C₁-C₂₄alkyl, and R²⁷ is C₁-C₂₄alkyl, or

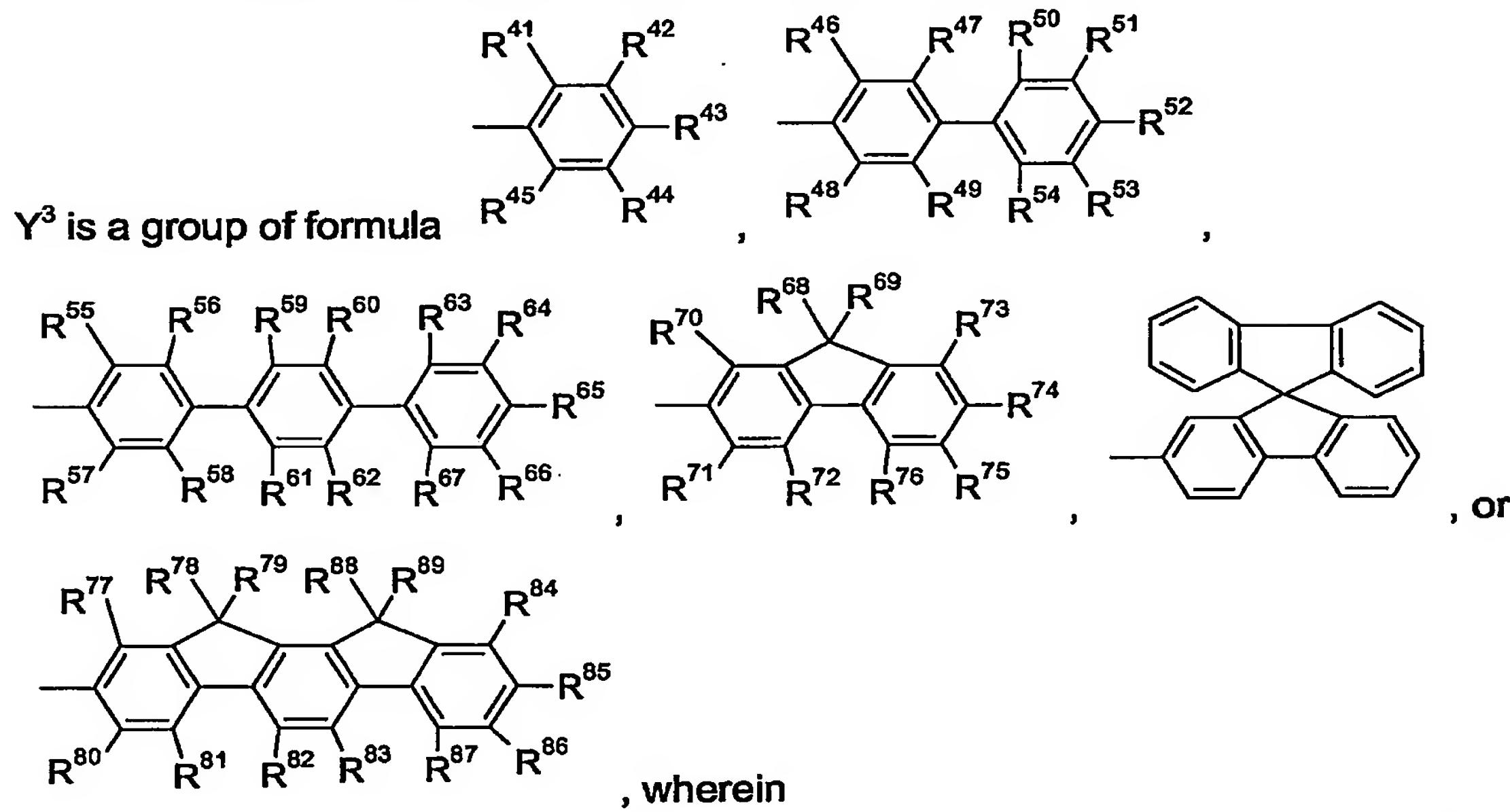


R^{25} and R^{26} together form a five or six membered ring, in particular

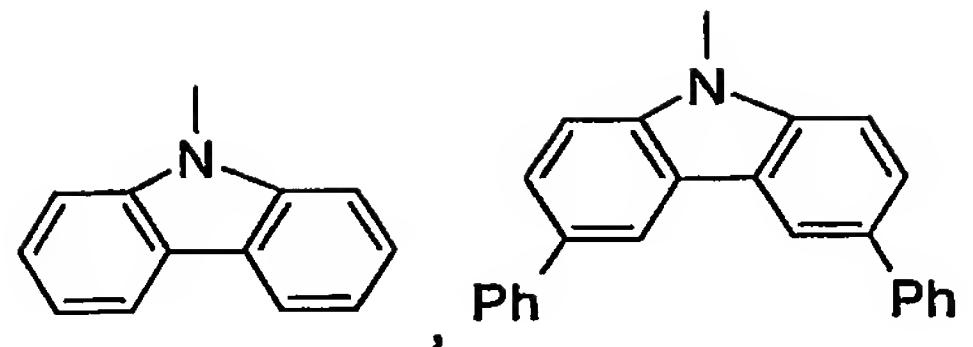


E^2 is -S-, -O-, or $-NR^{25}-$, wherein R^{25} is C_1-C_{24} alkyl, or C_6-C_{10} aryl.

5 4. A 2H-benzotriazole compound according to claim 1, wherein

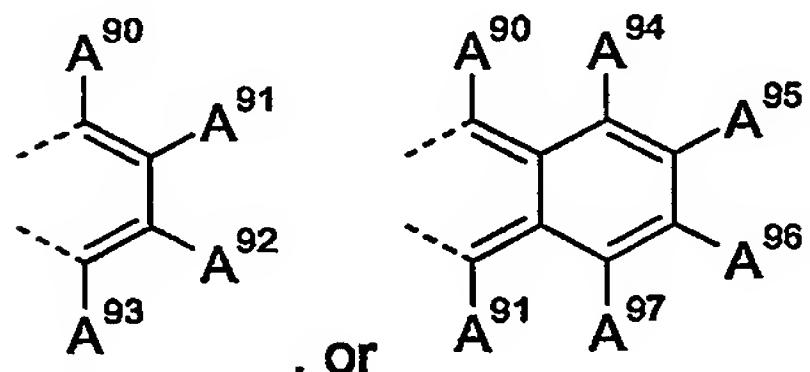


$R^{41}, R^{42}, R^{43}, R^{44}, R^{45}, R^{46}, R^{47}, R^{48}, R^{49}, R^{50}, R^{51}, R^{52}, R^{53}, R^{54}, R^{55}, R^{56}, R^{57}, R^{58}, R^{59}, R^{60}, R^{61}, R^{62}, R^{63}, R^{64}, R^{65}, R^{66}, R^{67}, R^{68}, R^{69}, R^{70}, R^{71}, R^{72}, R^{73}, R^{74}, R^{75}, R^{76}, R^{77}, R^{78}, R^{79}, R^{80}, R^{81}, R^{82}, R^{83}, R^{84}, R^{85}, R^{86}$, and R^{87} are independently of each other H, fluorine, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially pentafluorophenyl, $-NR^{25}R^{26}$, C_1-C_{24} alkyl, which is optionally substituted by E and/or interrupted by D , C_1-C_{24} alkenyl, which is optionally substituted by E , C_5-C_{12} cycloalkyl, which is optionally substituted by G , C_5-C_{12} cycloalkoxy, which is optionally substituted by G , C_6-C_{18} aryl, which is optionally substituted by G , C_1-C_{24} alkoxy, which is optionally substituted by E and/or interrupted by D , C_6-C_{18} aryloxy, which is optionally substituted by G , C_7-C_{18} arylalkoxy, which is optionally substituted by G , C_1-C_{24} alkylthio, which is optionally substituted by E and/or interrupted by D , C_2-C_{20} heteroaryl which is substituted by G , or C_6-C_{18} aralkyl, which is optionally substituted by G , or



R^{43} , R^{65} or R^{52} are a group of formula

two groups R^{41} , R^{42} , R^{43} , R^{44} , R^{45} , R^{46} , R^{47} , R^{48} , R^{49} , R^{50} , R^{51} , R^{52} , R^{53} , R^{54} , R^{55} , R^{56} , R^{57} , R^{58} , R^{59} , R^{60} , R^{61} , R^{62} , R^{63} , R^{64} , R^{65} , R^{66} , R^{67} , R^{70} , R^{71} , R^{72} , R^{73} , R^{74} , R^{75} , R^{76} , R^{77} , R^{80} , R^{81} , R^{82} , R^{83} , R^{84} , R^{85} , R^{86} , and R^{87} , which are neighbouring to each other, are a group

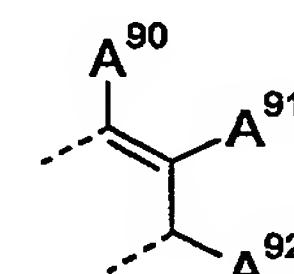


5 , or , wherein A⁹⁰, A⁹¹, A⁹², A⁹³, A⁹⁴, A⁹⁵, A⁹⁶ and A⁹⁷ are independently of each other H, halogen, especially fluorine, -NR²⁵R²⁶, hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by G, or -CO-R²⁸,

10 R⁶⁸, R⁶⁹, R⁷⁸, R⁷⁹, R⁸⁸ and R⁸⁹ are independently of each other C₁-C₁₈ alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, or C₇-C₂₅aralkyl, or

15 R⁶⁸ and R⁶⁹, R⁷⁸ and R⁷⁹, and/or R⁸⁸ and R⁸⁹ form a ring, especially a five- or six-membered ring, or

20 R⁶⁸ and R⁶⁹, R⁷⁸ and R⁷⁹, and/or R⁸⁸ and R⁸⁹ form a ring, especially a five- or six-membered ring, or

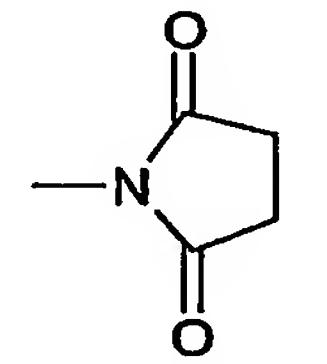


R^{68} and R^{70} , R^{69} and R^{73} , R^{77} and R^{78} and/or R^{84} and R^{89} are a group

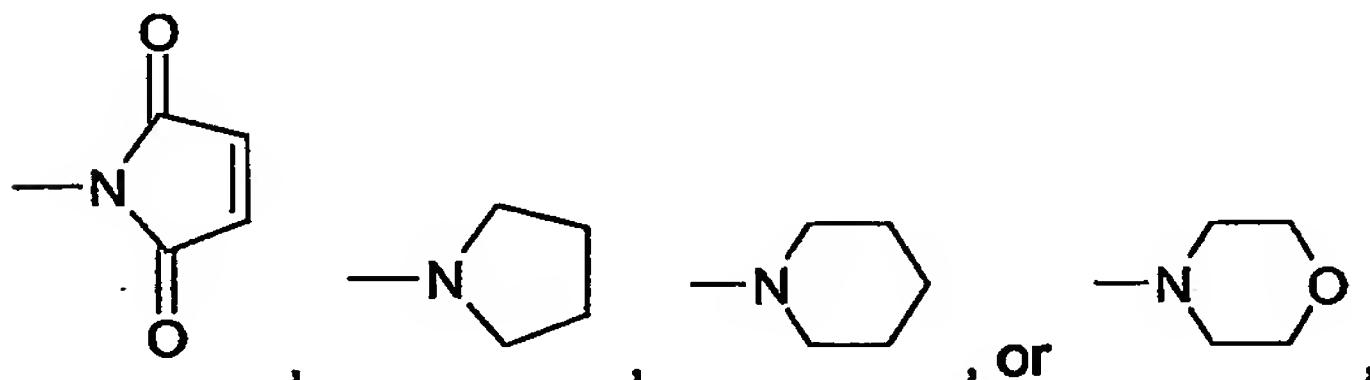
D is -CO-; -COO-; -S-; -SO-; -SO₂-; -O-; -NR²⁵-; -SiR³⁰R³¹-; -POR³²-; -CR²³=CR²⁴-; or -C≡C-; and

E is -OR²⁹; -SR²⁹; -NR²⁵R²⁶; -COR²⁸; -COOR²⁷; -CONR²⁵R²⁶; -CN; -OCOOR²⁷; or halogen; G is E, or C₁-C₂₄alkyl; wherein

R^{23} , R^{24} , R^{25} and R^{26} are independently of each other H; C_6 - C_{18} aryl; C_6 - C_{18} aryl which is substituted by C_1 - C_{24} alkyl, or C_1 - C_{24} alkoxy; C_1 - C_{24} alkyl; or C_1 - C_{24} alkyl which is interrupted by $-O-$; or



R^{25} and R^{26} together form a five or six membered ring, in particular



5

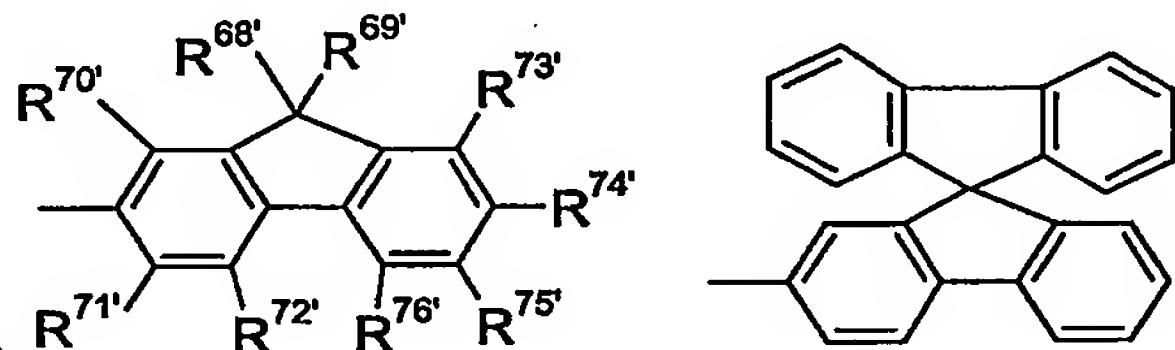
R^{27} and R^{28} are independently of each other H; C_6 - C_{18} aryl; C_6 - C_{18} aryl which is substituted by C_1 - C_{24} alkyl, or C_1 - C_{24} alkoxy; C_1 - C_{24} alkyl; or C_1 - C_{24} alkyl which is interrupted by $-O-$,

10

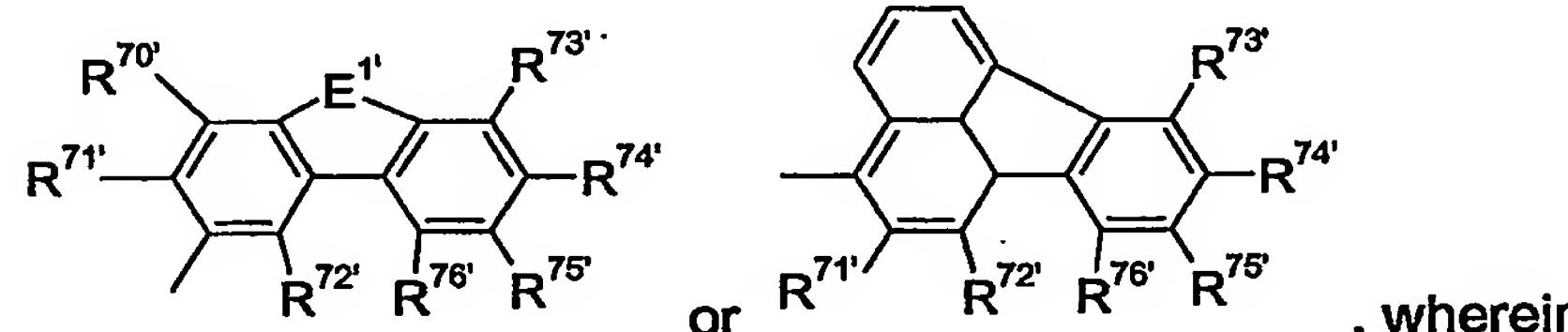
R^{29} is H; C_6 - C_{18} aryl; C_6 - C_{18} aryl, which is substituted by C_1 - C_{24} alkyl, or C_1 - C_{24} alkoxy; C_1 - C_{24} alkyl; or C_1 - C_{24} alkyl which is interrupted by $-O-$,

R^{30} and R^{31} are independently of each other C_1 - C_{24} alkyl, C_6 - C_{18} aryl, or C_6 - C_{18} aryl, which is substituted by C_1 - C_{24} alkyl, and

R^{32} is C_1 - C_{24} alkyl, C_6 - C_{18} aryl, or C_6 - C_{18} aryl, which is substituted by C_1 - C_{24} alkyl, or



R^{43} is a group of formula



15

$R^{68'}$ and $R^{69'}$ are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, which can be interrupted by one or two oxygen atoms,

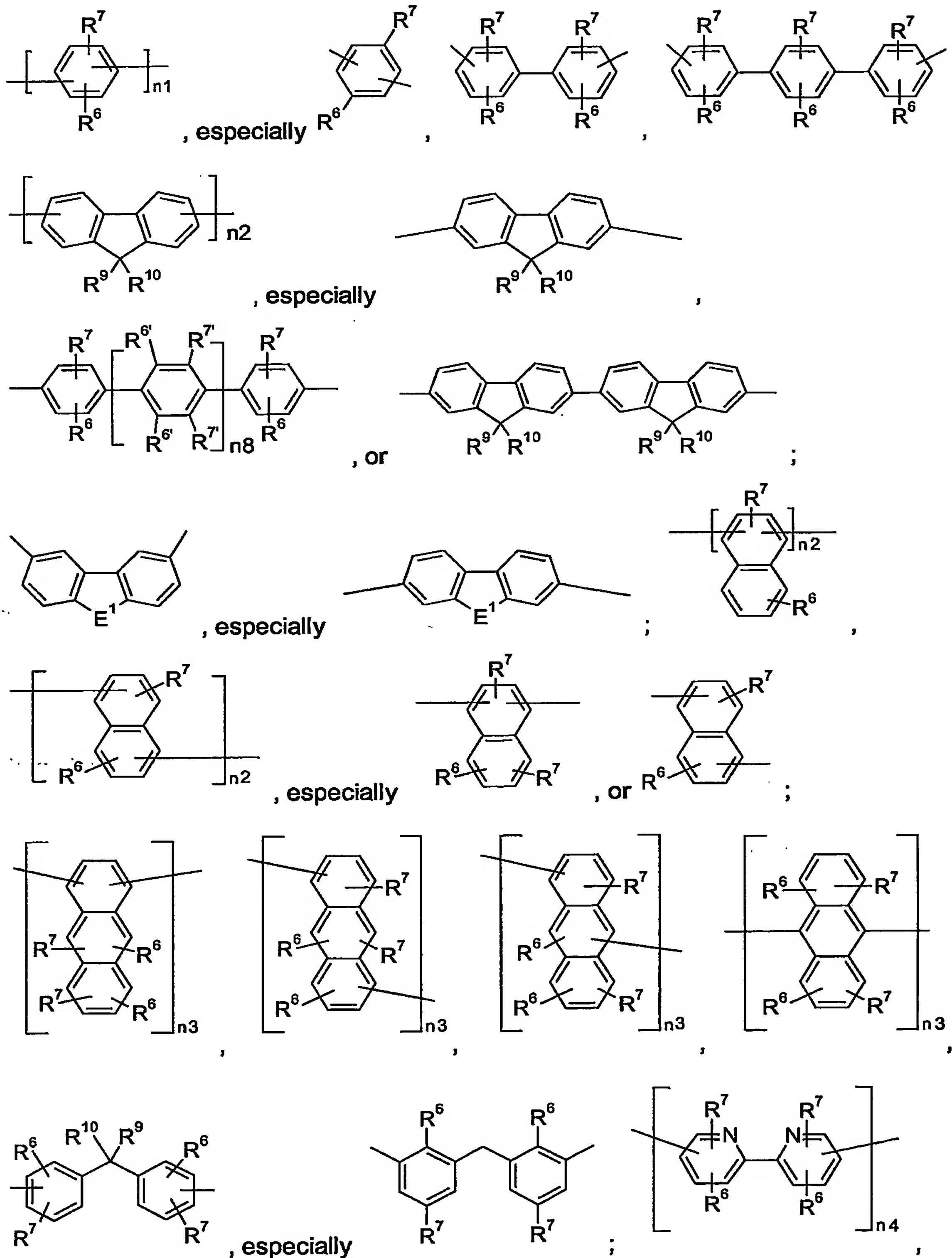
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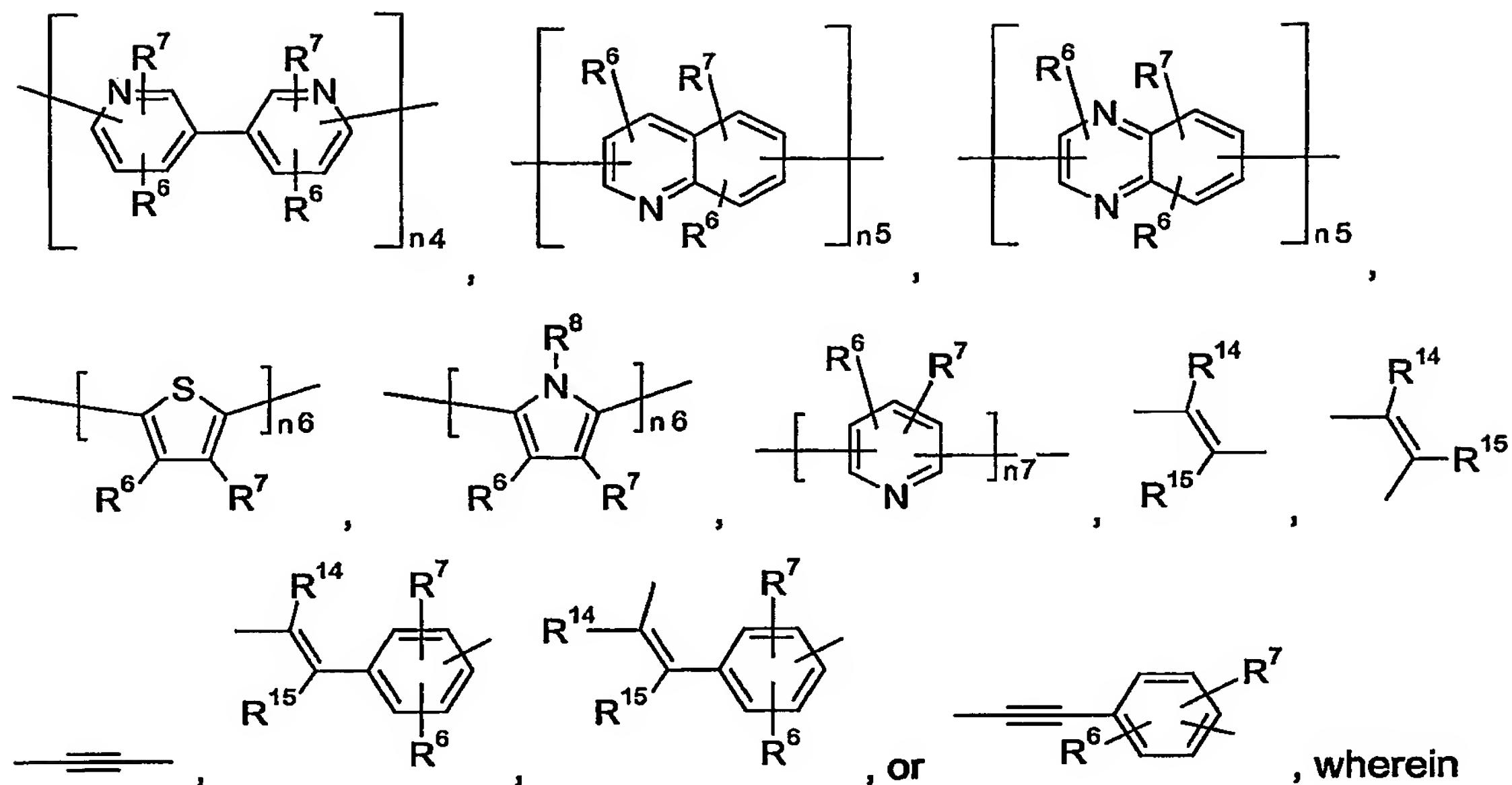
$R^{70'}$, $R^{71'}$, $R^{72'}$, $R^{73'}$, $R^{74'}$, $R^{75'}$ and $R^{76'}$ are independently of each other H, CN, C_1 - C_{24} alkyl, C_6 - C_{10} aryl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25'}R^{26'}$, $-CONR^{25'}R^{26'}$, or $-COOR^{27'}$,

$R^{25'}$ and $R^{26'}$ are independently of each other H, C_6 - C_{18} aryl, C_7 - C_{18} aralkyl, or C_1 - C_{24} alkyl, and $R^{27'}$ is C_1 - C_{24} alkyl; and

E^1 is $-S-$, $-O-$, or $-NR^{25'}-$, wherein $R^{25'}$ is C_1 - C_{24} alkyl, or C_6 - C_{10} aryl.

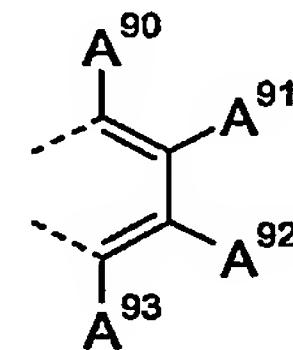
5. A 2H-benzotriazole compound to claim 1, wherein Y¹ is a group of formula





n1, n2, n3, n4, n5, n6, n7 and n8 are 1, 2, or 3, in particular 1,

5 E¹ is -S-, -O-, or -NR²⁵-, wherein R²⁵ is C₁-C₂₄alkyl, or C₆-C₁₀aryl,
R⁶ and R⁷ are independently of each other H, halogen, especially fluorine, -NR²⁵R²⁶,
hydroxy, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-
C₂₄perfluoroalkyl, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl,
C₅-C₁₂cycloalkyl which is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-
10 C₁₂cycloalkoxy, C₅-C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl
which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G,
C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E
and/or interrupted by D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-
C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by G, or -CO-R²⁸,



15 R⁶ and R⁷ have the meaning of R⁶, or together form a group , wherein A⁹⁰,
A⁹¹, A⁹², and A⁹³ are independently of each other H, halogen, hydroxy, C₁-C₂₄alkyl, C₁-
C₂₄alkyl which is substituted by E and/or interrupted by D, C₁-C₂₄perfluoroalkyl, C₆-
C₁₄perfluoroaryl, especially pentafluorophenyl, C₅-C₁₂cycloalkyl, C₅-C₁₂cycloalkyl which
is substituted by G and/or interrupted by S-, -O-, or -NR²⁵-, C₅-C₁₂cycloalkoxy, C₅-
C₁₂cycloalkoxy which is substituted by G, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by
G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-
C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by

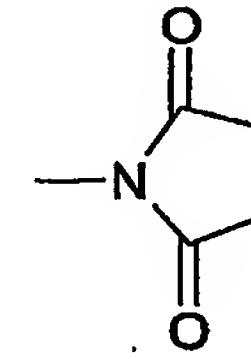
D, C₇-C₂₅aralkyl, C₇-C₂₅aralkyl, which is substituted by G, C₇-C₂₅aralkoxy, C₇-C₂₅aralkoxy which is substituted by E, or -CO-R²⁸, R⁸ is C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₆-C₂₄aryl, or C₇-C₂₅aralkyl,

5 R⁹ and R¹⁰ are independently of each other C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, C₂-C₂₀heteroaryl which is substituted by G, C₂-C₂₄alkenyl, C₂-C₂₄alkynyl, C₁-C₂₄alkoxy, C₁-C₂₄alkoxy which is substituted by E and/or interrupted by D, or C₇-C₂₅aralkyl, or

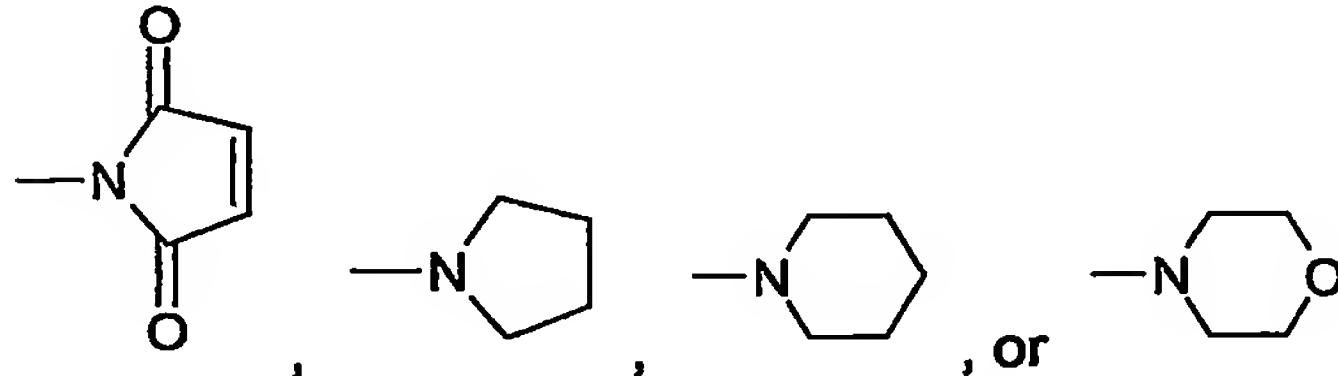
10 R⁹ and R¹⁰ form a ring, especially a five- or six-membered ring, R¹⁴ and R¹⁵ are independently of each other H, C₁-C₂₄alkyl, C₁-C₂₄alkyl which is substituted by E and/or interrupted by D, C₆-C₂₄aryl, C₆-C₂₄aryl which is substituted by G, C₂-C₂₀heteroaryl, or C₂-C₂₀heteroaryl which is substituted by G, D is -CO-, -COO-, -S-, -SO-, -SO₂-, -O-, -NR²⁵-, -SiR³⁰R³¹-, -POR³²-, -CR²³=CR²⁴-, or -C≡C-, G is E, or C₁-C₂₄alkyl, and

15 E is -OR²⁹, -SR²⁹, -NR²⁵R²⁶, -COR²⁸, -COOR²⁷, -CONR²⁵R²⁶, -CN, -OCOOR²⁷, or halogen, wherein R²³, R²⁴, R²⁵ and R²⁶ are independently of each other H, C₆-C₁₈aryl, C₆-C₁₈aryl which is substituted by C₁-C₂₄alkyl, C₁-C₂₄alkoxy, C₁-C₂₄alkyl, or C₁-C₂₄alkyl which is interrupted by -O-, or

20



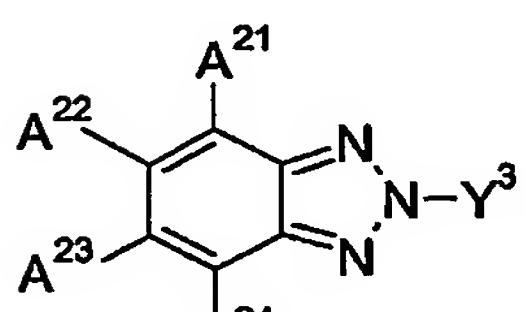
R²⁵ and R²⁶ together form a five or six membered ring, in particular



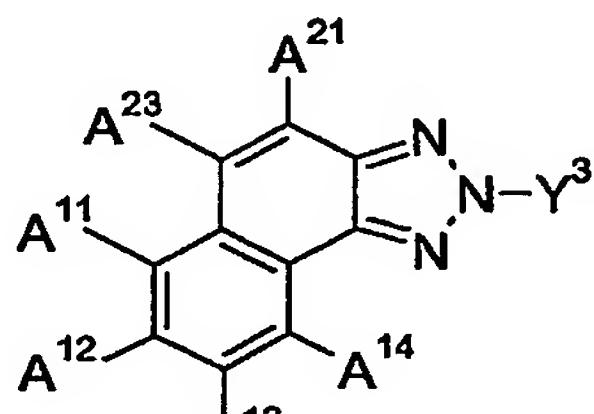
25 R²⁷ and R²⁸ are independently of each other H, C₆-C₁₈aryl, C₆-C₁₈aryl which is substituted by C₁-C₂₄alkyl, or C₁-C₂₄alkoxy, C₁-C₂₄alkyl, or C₁-C₂₄alkyl which is interrupted by -O-, R²⁹ is H, C₆-C₁₈aryl, C₆-C₁₈aryl, which is substituted by C₁-C₂₄alkyl, C₁-C₂₄alkoxy, C₁-C₂₄alkyl, or C₁-C₂₄alkyl which is interrupted by -O-, R³⁰ and R³¹ are independently of each other C₁-C₂₄alkyl, C₆-C₁₈aryl, or C₆-C₁₈aryl, which is substituted by C₁-C₂₄alkyl, and

R^{32} is C_1-C_{24} alkyl, C_6-C_{18} aryl, or C_6-C_{18} aryl, which is substituted by C_1-C_{24} alkyl.

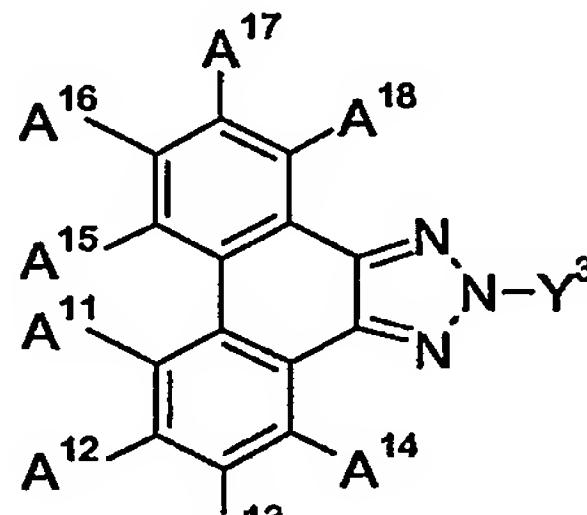
6. A 2H-benzotriazole compound to claim 1, wherein the 2H-benzotriazole compound is a compound of formula



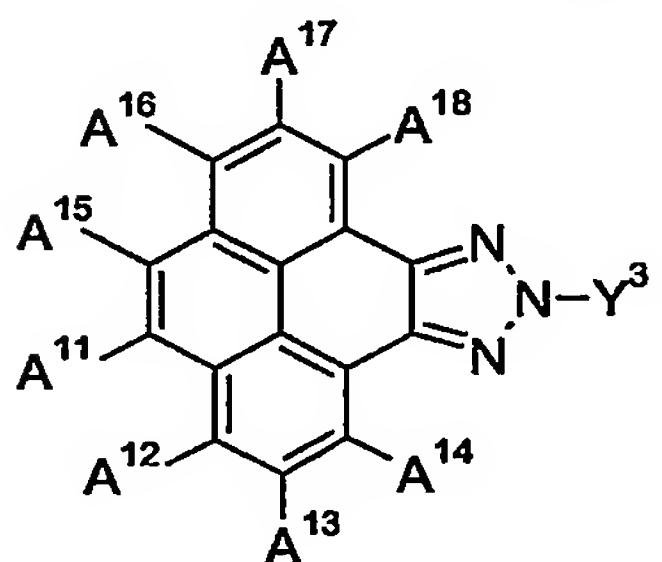
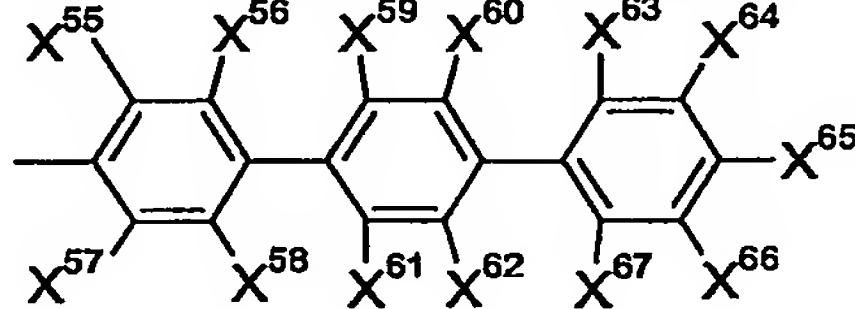
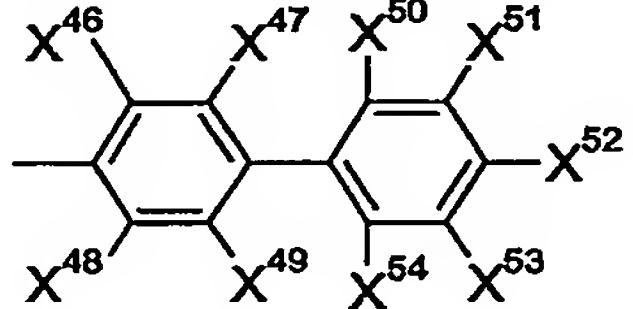
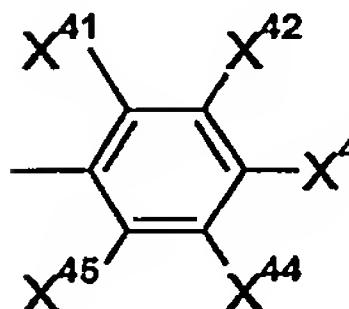
(Ia),



(Ib),



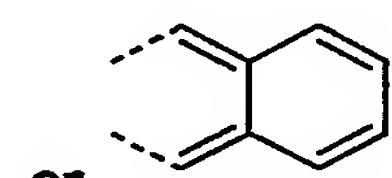
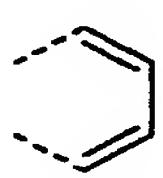
(Ic), or

(Id), wherein A^{12} or A^{23} are a group of formula

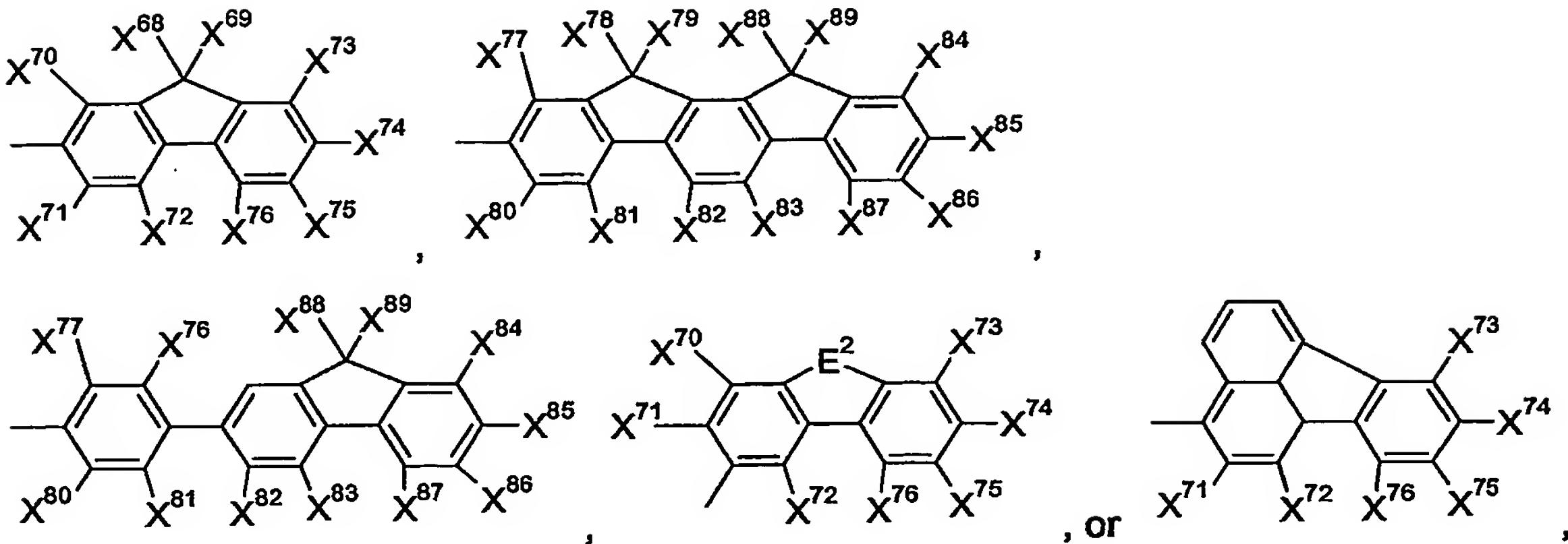
, wherein

$X^{41}, X^{42}, X^{43}, X^{44}, X^{45}, X^{46}, X^{47}, X^{48}, X^{49}, X^{50}, X^{51}, X^{52}, X^{53}, X^{54}, X^{55}, X^{56}, X^{57}, X^{58}, X^{59}, X^{60}, X^{61}, X^{62}, X^{63}, X^{64}, X^{65}, X^{66}$ and X^{67} are independently of each other are independently of

each other H, CN, fluorine, C_1-C_{24} alkyl, C_5-C_{12} cycloalkyl, C_7-C_{25} aralkyl, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially pentafluorophenyl, C_1-C_{24} haloalkyl, C_6-C_{10} aryl, which can optionally be substituted by one, or more C_1-C_8 alkyl, or C_1-C_8 alkoxy groups; C_1-C_{24} alkoxy, C_1-C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or two groups $X^{41}, X^{42}, X^{43}, X^{44}, X^{45}, X^{46}, X^{47}, X^{48}, X^{49}, X^{50}, X^{51}, X^{52}, X^{53}, X^{54}, X^{55}, X^{56}, X^{57}, X^{58}, X^{59}, X^{60}, X^{61}, X^{62}, X^{63}, X^{64}, X^{65}, X^{66}$ and X^{67} , which are neighbouring to each other,



are a group , or , wherein preferably at least one of the substituents $X^{41}, X^{42}, X^{43}, X^{44}, X^{45}, X^{46}, X^{47}, X^{48}, X^{49}, X^{50}, X^{51}, X^{52}, X^{53}, X^{54}, X^{55}, X^{56}, X^{57}, X^{58}, X^{59}, X^{60}, X^{61}, X^{62}, X^{63}, X^{64}, X^{65}, X^{66}$ and X^{67} is fluorine, $-NR^{25}R^{26}$, C_1-C_{24} alkyl, C_5-C_{12} cycloalkyl, C_7-C_{25} aralkyl, C_1-C_{24} perfluoroalkyl, C_6-C_{14} perfluoroaryl, especially pentafluorophenyl, or C_1-C_{24} haloalkyl, or A^{12} and A^{23} are a group of formula



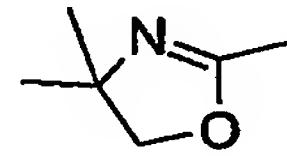
wherein

X^{68} , X^{69} , X^{78} , X^{79} , X^{88} and X^{89} are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, which can be interrupted by one or two oxygen atoms,

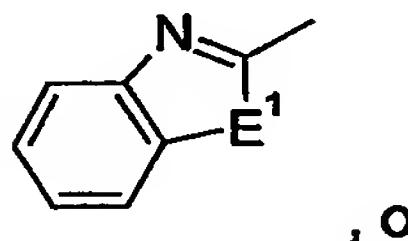
5 X^{70} , X^{71} , X^{72} , X^{73} , X^{74} , X^{75} , X^{76} , X^{77} , X^{80} , X^{81} , X^{82} , X^{83} , X^{84} , X^{85} , X^{86} and X^{87} are independently of each other H, CN, C_1 - C_{24} alkyl, C_6 - C_{10} aryl, which can optionally be substituted by one, or more C_1 - C_8 alkyl, or C_1 - C_8 alkoxy groups; C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$,

10 E^2 is $-S-$, $-O-$, or $-NR^{25}-$, wherein R^{25} is C_1 - C_{24} alkyl, or C_6 - C_{10} aryl, A^{21} , A^{22} and A^{24} are independently of each other hydrogen, halogen, especially fluorine, C_1 - C_{24} alkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} haloalkyl, C_6 - C_{18} aryl, which can optionally be substituted by one, or more C_1 - C_8 alkyl, or C_1 - C_8 alkoxy groups; $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$,

15 or $-COOR^{27}$, or C_2 - C_{10} heteroaryl, especially a group of formula



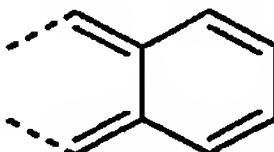
or



, or



, or

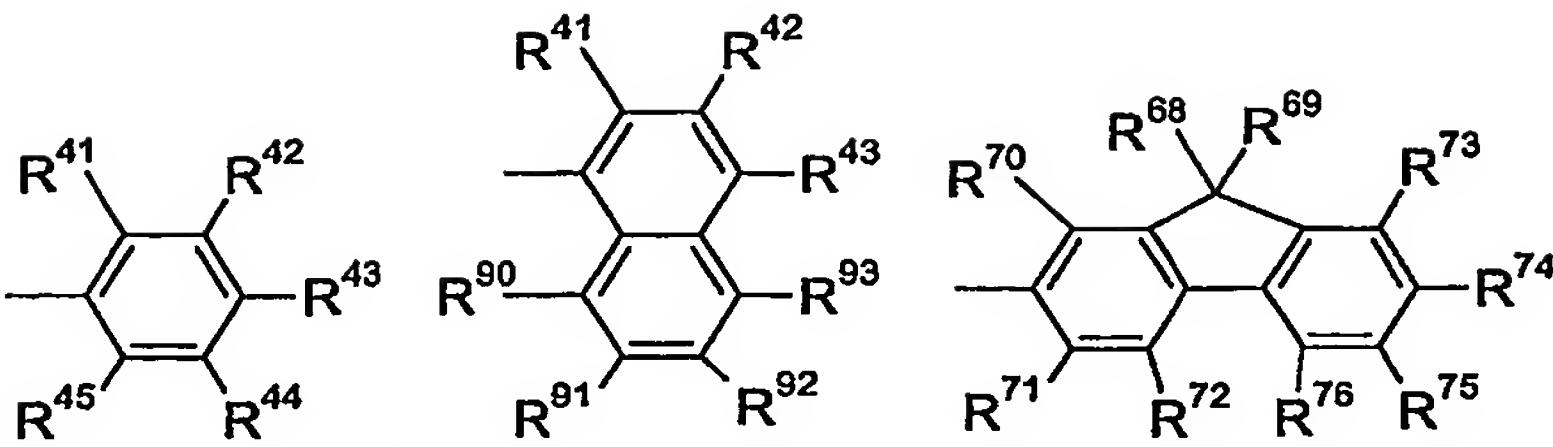


, or

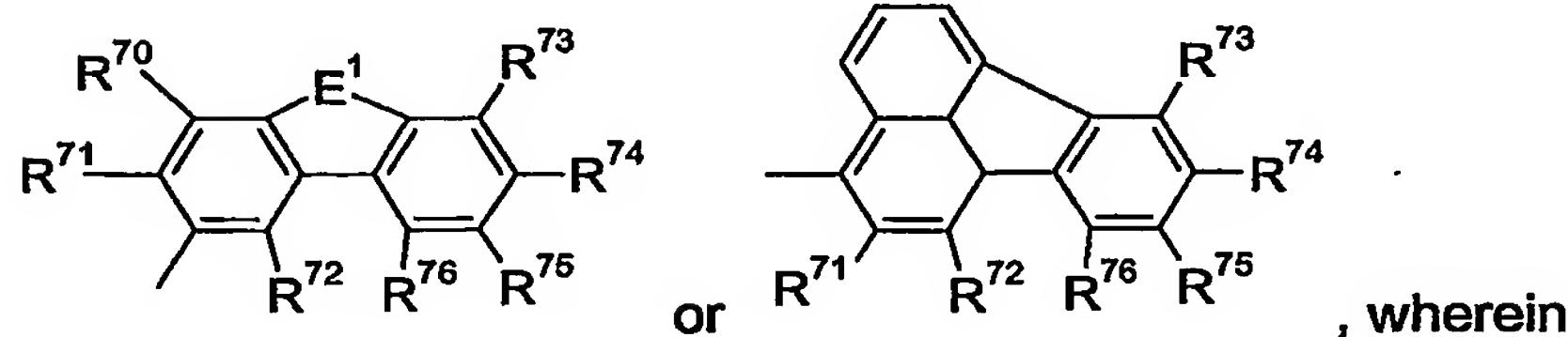
A^{22} and A^{23} or A^{11} and A^{23} are a group of formula

20 A^{11} , A^{13} , A^{14} , A^{15} , A^{16} , A^{17} , and A^{18} are independently of each other H, CN, C_1 - C_{24} alkyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, C_1 - C_{24} haloalkyl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, C_6 - C_{18} aryl, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or C_2 - C_{10} heteroaryl, wherein R^{25} and R^{26} are independently of each other H, C_6 - C_{18} aryl, C_7 - C_{18} aralkyl, or C_1 - C_{24} alkyl, R^{27} is C_1 - C_{24} alkyl, and

62



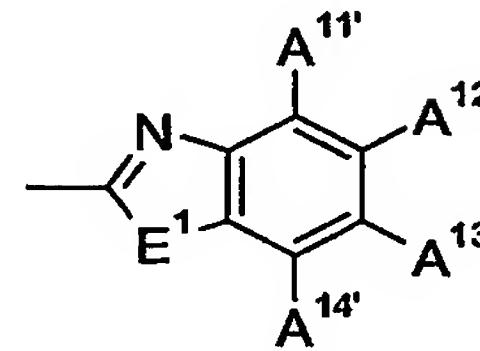
Y³ is a group of formula



, wherein

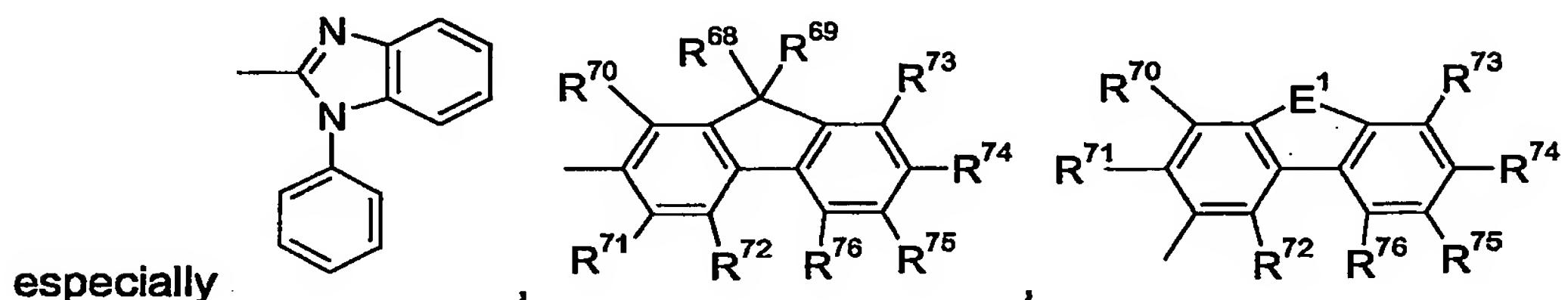
R⁴¹ is hydrogen, C₁-C₂₄alkoxy, or -OC₇-C₁₈aralkyl,

R⁴² is hydrogen, or C₁-C₂₄alkyl,

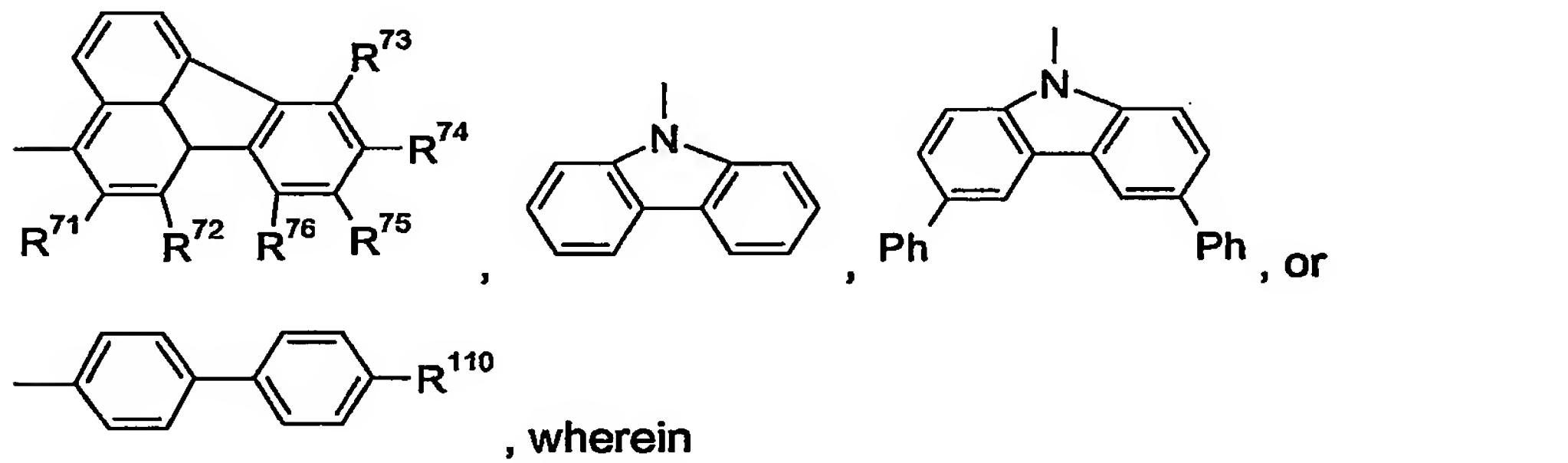


5

R⁴³ is hydrogen, halogen, -CONR²⁵R²⁶, -COOR²⁷,



especially



A¹¹, A¹², A¹³, and A¹⁴ are independently of each other H, CN, C₁-C₂₄alkyl, C₁-C₂₄alkoxy, C₁-C₂₄alkylthio, -NR²⁵R²⁶, -CONR²⁵R²⁶, or -COOR²⁷,
E¹ is -S-, -O-, or -NR²⁵-, wherein R²⁵ is C₁-C₂₄alkyl, or C₆-C₁₀aryl,
R¹¹⁰ is H, CN, C₁-C₂₄alkyl, C₁-C₂₄alkoxy, C₁-C₂₄alkylthio, -NR²⁵R²⁶, -CONR²⁵R²⁶, or
-COOR²⁷, or



R⁴² and R⁴³ are a group of formula

15

R⁴⁴ is hydrogen, or C₁-C₂₄alkyl,

R^{45} is hydrogen, or C_1 - C_{24} alkyl,

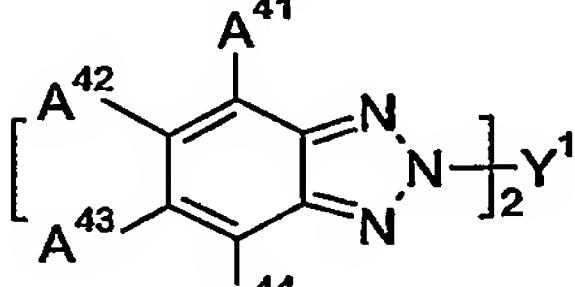
R^{68} and R^{69} are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, which can be interrupted by one or two oxygen atoms,

R^{70} , R^{71} , R^{72} , R^{73} , R^{74} , R^{75} , R^{76} , R^{80} , R^{91} , R^{92} , and R^{93} are independently of each other

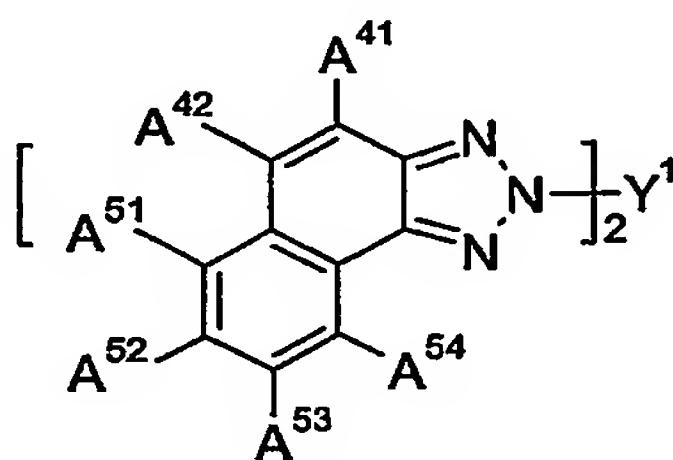
5 H, CN, C_1 - C_{24} alkyl, C_6 - C_{10} aryl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$,

R^{25} and R^{26} are independently of each other H, C_6 - C_{18} aryl, C_7 - C_{18} aralkyl, or C_1 - C_{24} alkyl, and R^{27} is C_1 - C_{24} alkyl.

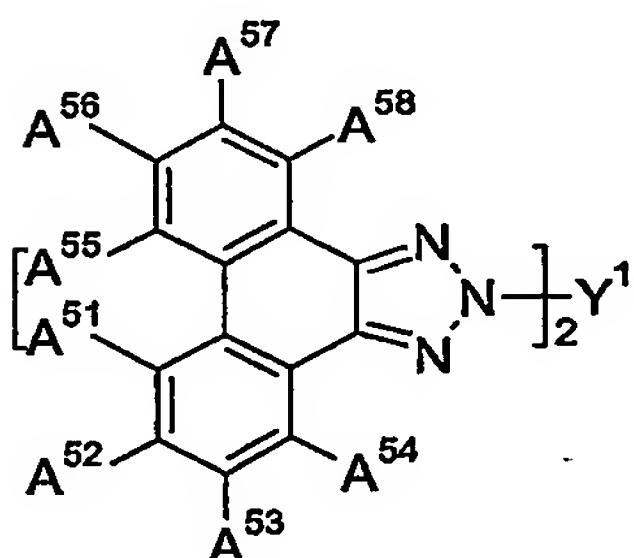
10 7. A 2H-benzotriazole compound according to claim 1, wherein the 2H-benzotriazole compound is a compound of formula



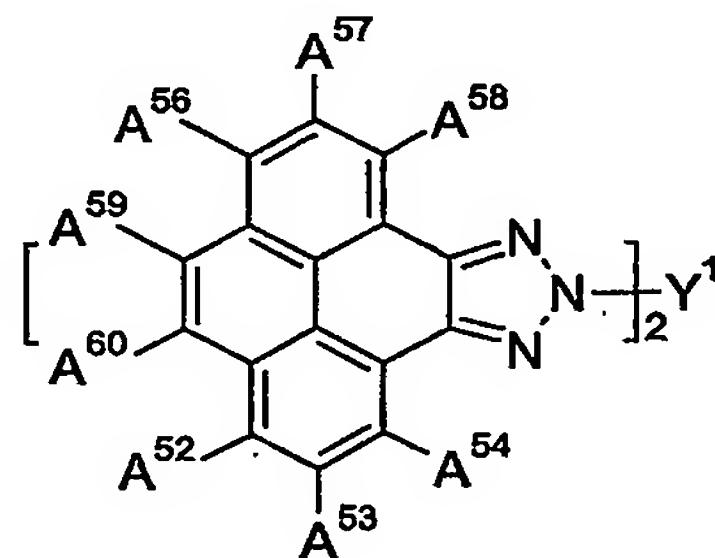
(IIa),



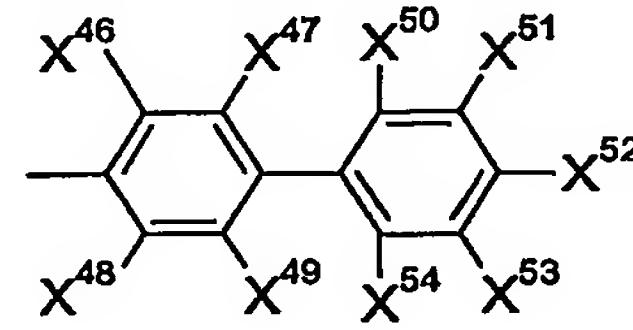
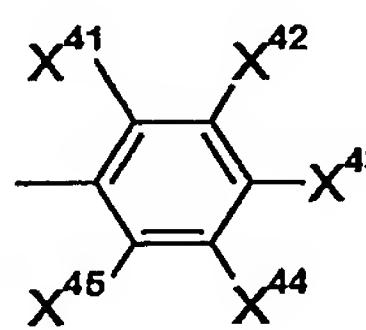
(IIb),



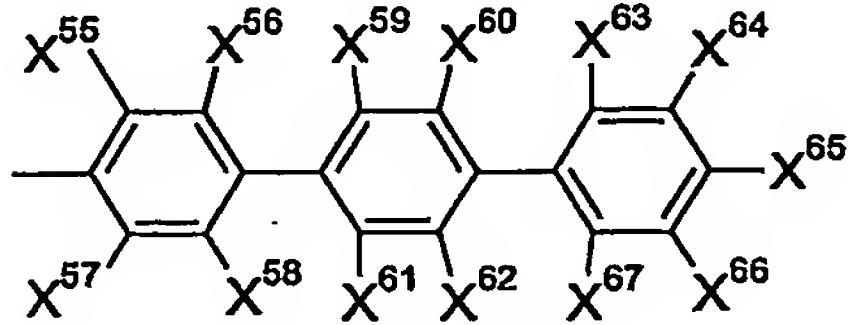
(IIc), or



(IId), wherein



wherein A^{52} and A^{43} are a group of formula

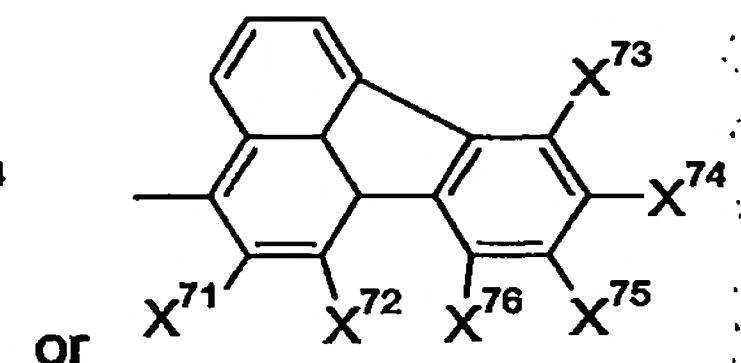
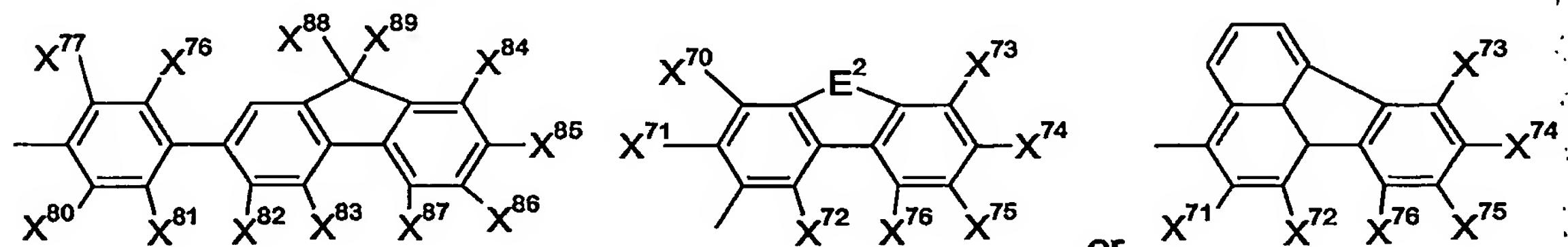
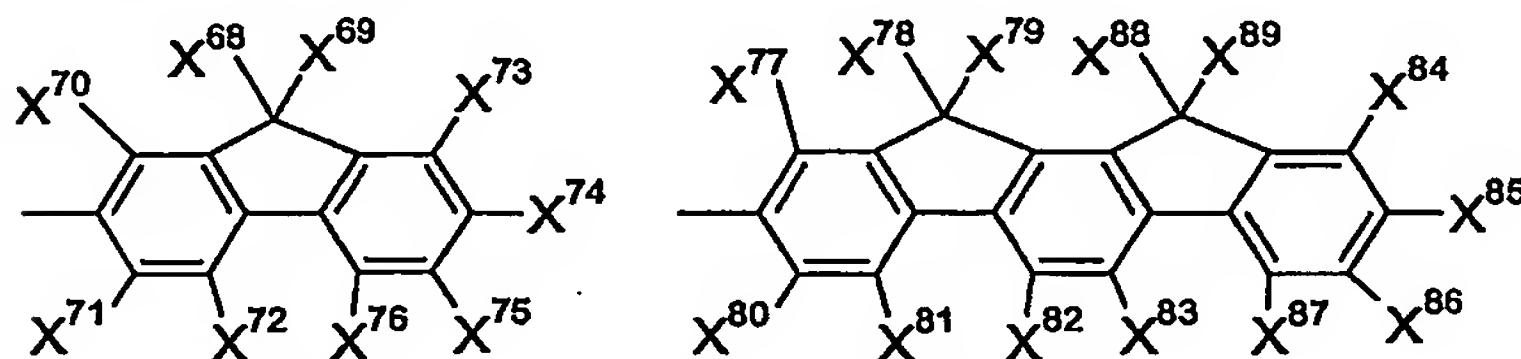


15 , wherein X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} are independently of each other are independently of each other H, fluorine, CN, C_1 - C_{24} alkyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, or C_1 - C_{24} haloalkyl, C_6 - C_{10} aryl, which can optionally be substituted by one, or more C_1 - C_8 alkyl, or C_1 - C_8 alkoxy groups;

C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or
two groups X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} ,
 X^{58} , X^{59} , X^{60} , X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} , which are neighbouring to each other,



are a group , or , wherein preferably at least one of the substituents
5 X^{41} , X^{42} , X^{43} , X^{44} , X^{45} , X^{46} , X^{47} , X^{48} , X^{49} , X^{50} , X^{51} , X^{52} , X^{53} , X^{54} , X^{55} , X^{56} , X^{57} , X^{58} , X^{59} , X^{60} ,
 X^{61} , X^{62} , X^{63} , X^{64} , X^{65} , X^{66} and X^{67} is fluorine, $-NR^{25}R^{26}$, C_1 - C_{24} alkyl, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, or C_1 - C_{24} haloalkyl, or A^{43} or A^{52} are a group of formula



wherein

X^{68} , X^{69} , X^{78} , X^{79} , X^{88} and X^{89} are independently of each other C_1 - C_{24} alkyl, especially C_1 - C_{12} alkyl, which can be interrupted by one or two oxygen atoms,

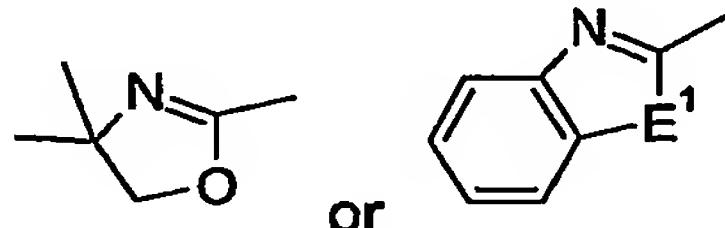
X^{70} , X^{71} , X^{72} , X^{73} , X^{74} , X^{75} , X^{76} , X^{77} , X^{80} , X^{81} , X^{82} , X^{83} , X^{84} , X^{85} , X^{86} and X^{87} are

15 independently of each other H, CN, C_1 - C_{24} alkyl, C_6 - C_{10} aryl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$,

E^2 is $-S-$, $-O-$, or $-NR^{25}-$,

A^{41} , A^{42} and A^{44} are independently of each other hydrogen, halogen, C_1 - C_{24} alkyl, C_1 - C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, C_5 - C_{12} cycloalkyl,

20 C_7 - C_{25} aralkyl, C_1 - C_{24} haloalkyl, C_6 - C_{18} aryl, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or C_2 -



C_{10} heteroaryl, especially a group of formula

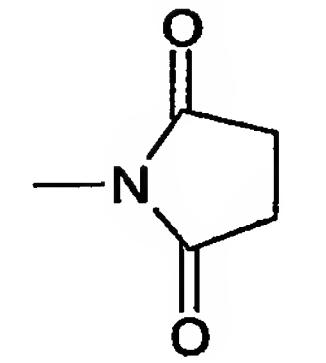
25 A^{51} , A^{53} , A^{54} , A^{55} , A^{56} , A^{57} , A^{58} , A^{59} and A^{60} are independently of each other H, fluorine,

CN, C_1 - C_{24} alkyl, C_1 - C_{24} alkoxy, C_1 - C_{24} alkylthio, C_5 - C_{12} cycloalkyl, C_7 - C_{25} aralkyl, C_1 -

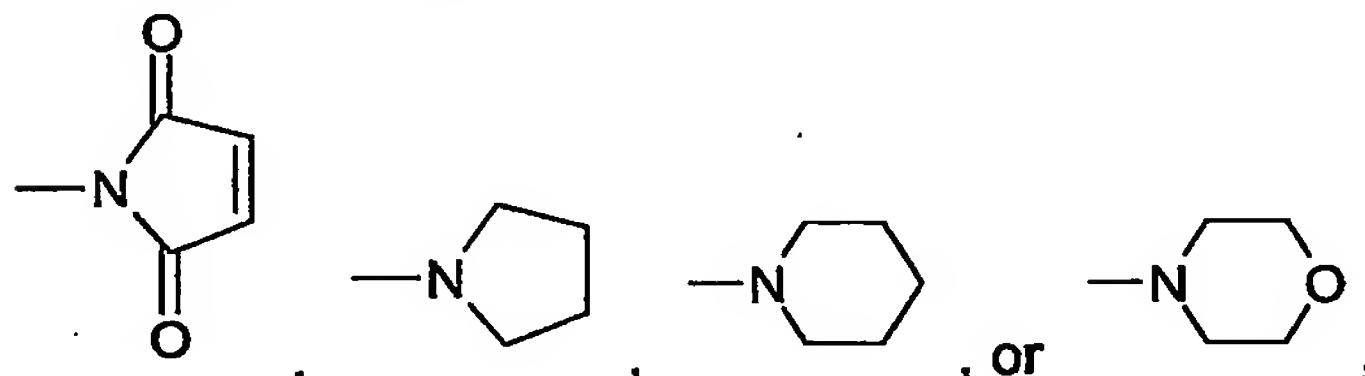
C_{24} perfluoroalkyl, C_6 - C_{14} perfluoroaryl, especially pentafluorophenyl, C_1 - C_{24} haloalkyl,

C_6 - C_{18} aryl, $-NR^{25}R^{26}$, $-CONR^{25}R^{26}$, or $-COOR^{27}$, or C_2 - C_{10} heteroaryl, wherein E^1 is O, S, or $-NR^{25}-$,

R^{25} and R^{26} are independently of each other H, C₆-C₁₈aryl, C₇-C₁₈aralkyl, or C₁-C₂₄alkyl,

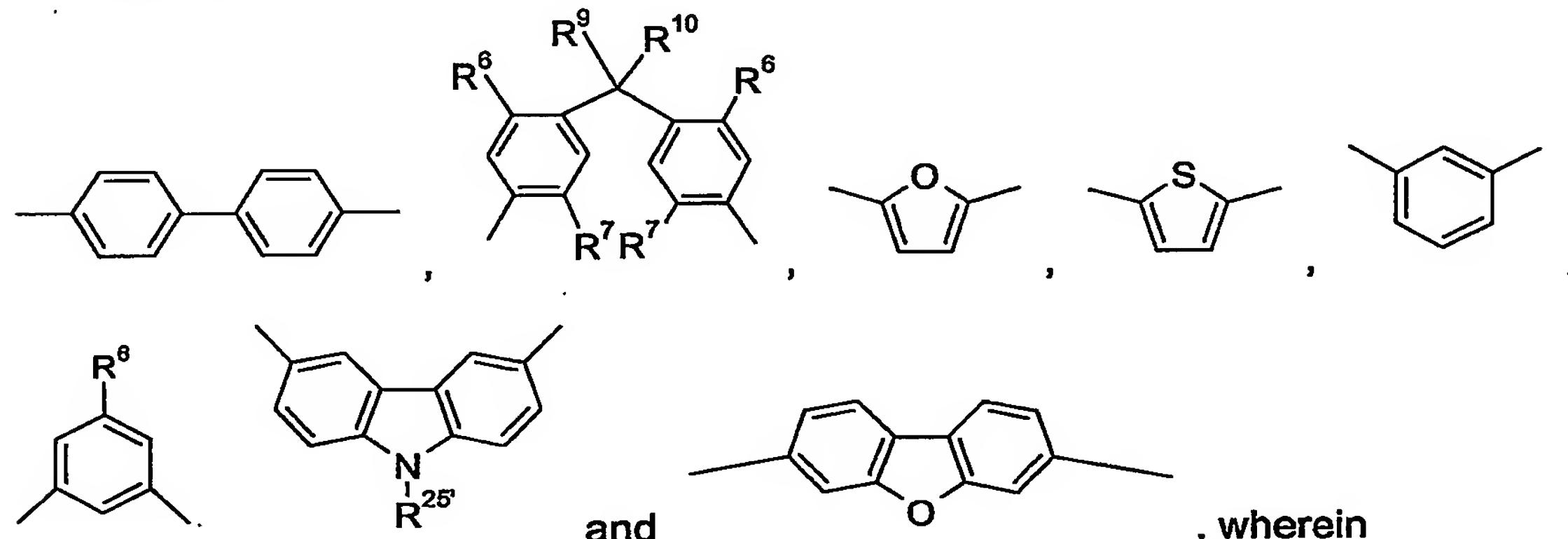


or R^{25} and R^{26} together form a five or six membered ring, in particular



R^{27} is C₁-C₂₄alkyl, and

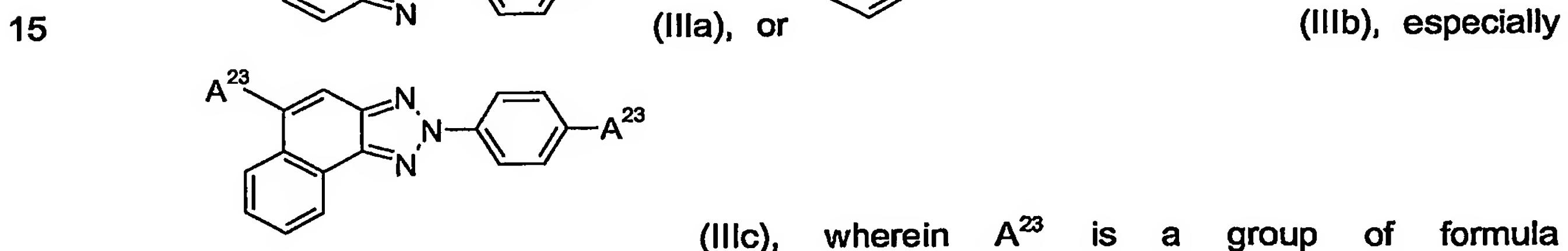
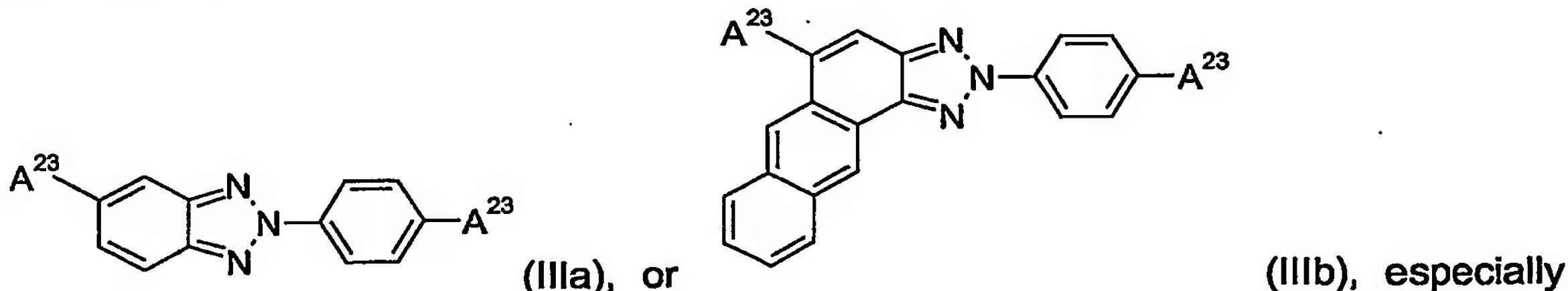
5 Y^1 is a group of formula

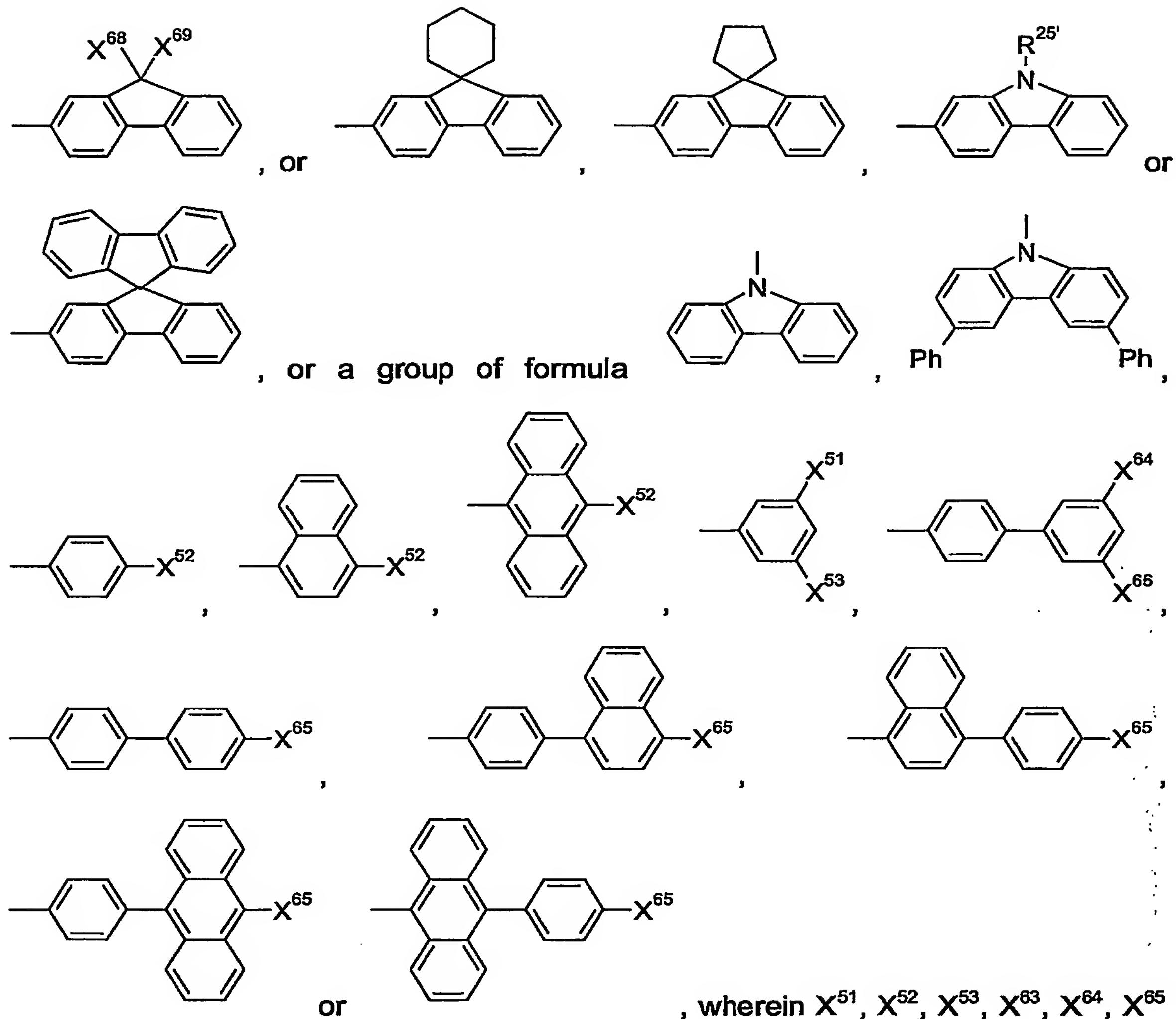


10 R^6 is C₁-C₂₄alkoxy, or -O-C₇-C₂₅aralkyl, R^7 is H, or C₁-C₂₄alkyl, R^8 and R^{10} are independently of each other C₁-C₂₄alkyl, especially C₄-C₁₂alkyl, which can be interrupted by one or two oxygen atoms, and

R^{25} is C₁-C₂₄alkyl, or C₆-C₁₀aryl.

8. A 2H-benzotriazole compound according to claim 1, wherein the 2H-benzotriazole is a compound of formula



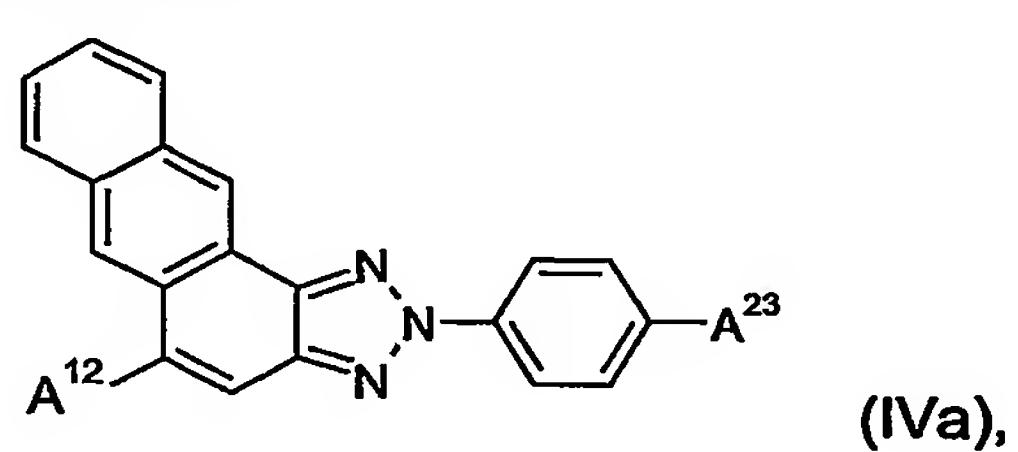
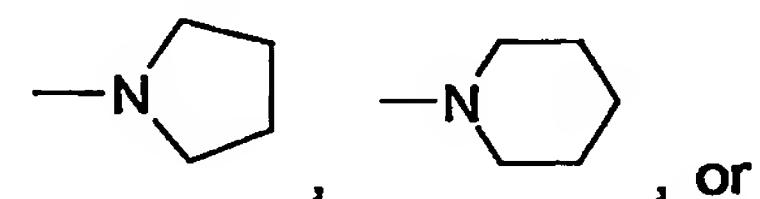


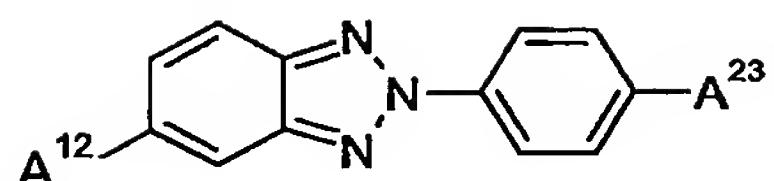
5

and X^{66} are independently of each other fluorine, C₁-C₂₄alkyl, especially C₁-C₁₂alkyl, very especially tert-butyl, C₅-C₁₂cycloalkyl, especially cyclohexyl, which can optionally be substituted by one, or two C₁-C₈alkyl groups, or 1-adamantyl, C₁-C₂₄perfluoroalkyl, especially C₁-C₁₂perfluoroalkyl, such as CF₃, C₆-C₁₄perfluoroaryl, especially pentafluorophenyl, NR²⁵R²⁶, wherein R²⁵ and R²⁶ are C₆-C₁₄aryl, especially phenyl, which can be substituted by one, or two C₁-C₂₄alkyl groups, or R²⁵ and R²⁶ together

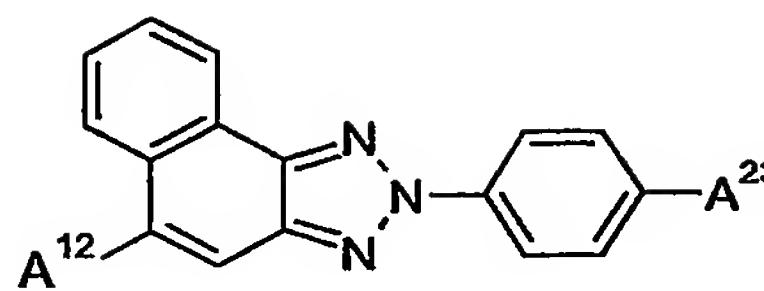
10

form a five or six membered heterocyclic ring, especially





(IVb), especially

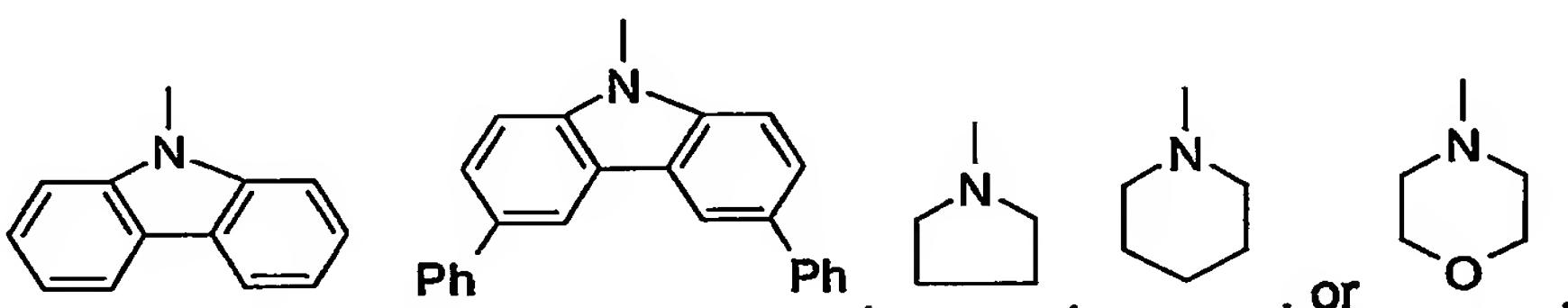


(IVc),

wherein

A^{23} is as defined above, wherein R^{25} is C_1-C_{12} alkyl, X^{68} and X^{69} are independently of each other C_1-C_{24} alkyl, especially C_1-C_{12} alkyl, and

5 A^{12} is $NR^{25}R^{26}$,



wherein R^{25} and R^{26} are C_6-C_{14} aryl, especially phenyl, 1-naphthyl, 2-naphthyl, which can optionally be substituted by one, or two C_1-C_8 alkyl groups, or C_1-C_8 alkoxy groups.

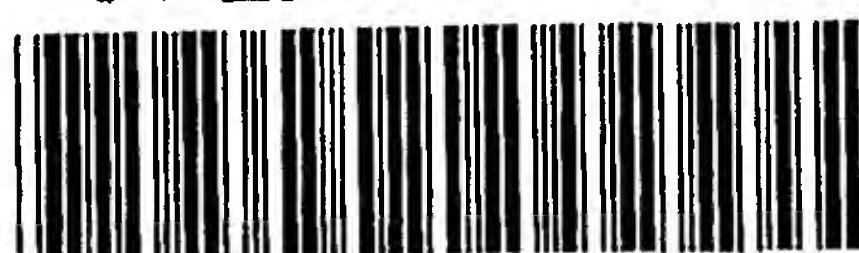
9. An electroluminescent device, comprising a 2H-benzotriazole compound according to any of claims 1 to 8.
10. The electroluminescent device according to claim 9, wherein the electroluminescent device comprises in this order
 - (a) an anode
 - (b) a hole injecting layer and/or a hole transporting layer
 - (c) a light-emitting layer
 - (d) optionally an electron transporting layer and
 - (e) a cathode.
11. The electroluminescent device according to claim 10, wherein the 2H-benzotriazole compound forms the light-emitting layer.
12. Use of the 2H-benzotriazole compounds according to any of claims 1 to 8 for electrophotographic photoreceptors, photoelectric converters, solar cells, image sensors, dye lasers and electroluminescent devices.

Abstract

Disclosed are electroluminescent devices that comprise organic layers that contain certain 2H-benzotriazole compounds. The 2H-benzotriazole compounds are suitable components of blue-emitting, durable, organo-electrouminescent layers. The electroluminescent devices

5 may be employed for full color display panels in, for example, mobile phones, televisions and personal computer screens.

101/EP_00435311



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